THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL.

VOL. 36. Thursday, September 15, 1927. No. 578.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial, 17s. 6d. per annum.
All Subscriptions are payable in advance.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telephone: Gerrard 3951 (4 lines).
Telegraphic Address: "Zacatecas, Rand, London."

Contents.

	PAGE
Tests and Testing Procedure	231
Foundry Exhibition in Paris	232
International Committee of Foundry Technical Associations	232
The Feeding and Gating of Steel Castings	233
A Note on Pulleys	236
Moulders' Mishaps	237
Some Aspects of Cast Iron as an Engineering Material	239
Brass Foundry Costing	240
Pattern Making and Foundry Costs	241
Silica Bricks for Steel Foundries	242
A Plumber's Adventure	243
Teaching the London Youth Foundry Work	243
Brass—a Historical Note	244
Automatic Crane Control in Iron Foundries	245
Foundry Purchasing—XIII	246
A Note about Patternmaking Costs	247
Random Shots	248
Trade Talk	248
Iron and Steel Markets	250
Company Reports	250
Personal	250
Gazette	250

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT, 1927-28:
John T. Goodwin, M.I.Mech.E.,
The Red House, Old Whittington, Chesterfield.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office, 49, Wellington Street, London, W.C.2.

Birmingham: F. K. Neath, 24, St. Paul's Square, Birmingham.

Sheffield: T. R. Walker, 26, Castlewood Road, Fulwood, Sheffield.

Scottish: J. Bell, 60, St. Enoch Square, Glasgow.

Lancashire: H. Stead, 1st/36, Cheetham Hill Road. Stalybridge, Cheshire.

London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

Newcastle-on-Tyne: F. Sanderson, 10, Westgate Road, Newcastle-on-Tyne.

East Midlands: H. Bunting, 17, Marcus Street, Derby.

West Riding of Yorkshire Branch: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.

Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitechurch, Glam.

Middlesbrough: N. D. Ridsdale, 3, Wilson Street, Middlesbrough.

Foundry Trades Equipment & Supplies Association.

President: Vincent C. Faulkner,
49, Wellington Street, London, W.C.2.

Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Welsh Engineers' and Founders' Association.

Secretary: F. J. Griffiths, 20, Fisher Street, Swansea.

Tests and Testing Procedure.

Considering again the question of specifications for cast iron, a tendency may be noted to regard an actual specification, that is to say, a formal statement of technical requirements, as being all that is required for securing uniformity between the grades of a particular material. A little reflection will indicate that this is not the case.

The specification will state the properties required, and it will give figures. In the most complicated cases they may partly or wholly cover chemical analysis, together with various mechanical and physical properties, such as tensile strength and elongation, transverse strength, hardness, etc. It is well known that difficulties are sometimes caused by discrepancies between the figures obtained in different laboratories, and consequently it is desirable not merely that a specification should embody definite test figures, but that the particular apparatus involved and the exact procedure to be followed should also be agreed upon. This need not be embodied in the first edition of the specification, but sooner or later the necessity for its incorporation is bound to be recognised.

In chemical analysis there are usually several methods of conducting a particular determination. If they do not give precisely the same result, which is to be employed? For research work we believe that the analyst should be free to choose whatever test appears to suit the end in view, but for the purpose of checking material in works laboratories we believe that the best procedure is to determine the most accurate, mistake-proof, and economical test and adhere to it, working out in detail the best way of doing it. It would then be possible to compare the results of different chemists. In any case chemists should be encouraged freely to test their determinations against standards such as are now available from several sources, so that they have a check on both standardised and non-standardised methods. The same remark applies in equal measure to all other common tests, mechanical, physical, microscopic. There is everything to be gained by determining both the best form of the equipment to be used and the best method of using it. The difficulties arising from the lack of such recognised equipment and methods may be illustrated by the case of the simple bend test for malleable iron. No test could apparently be simpler or easier to make, and yet it is not too much to say that at present it is impossible to compare the results from any two works or laboratories.

At the present time disputes arising from such discrepancies are unavoidable. The situation would be relieved by the adoption of such suggestions, together with the existence of a laboratory outside the interests concerned in a specification, which could act in the capacity of arbitrator.

The one handicap of close standardisation is that it fixes procedure without providing for its reconsideration in the light of later knowledge, often the very knowledge provided automatically by the existence of the standards themselves. Such a laboratory would offset this drawback so long as it were one capable of conducting investigations. Research work must go hand in hand with standardisation if the latter is not ultimately to spell stagnation, for at any time simpler and more satisfactory tests and methods may be devised.

Foundry Exhibition in Paris.

BY OUR FRENCH CORRESPONDENT.

This manifestation differs largely from previous efforts made by foundry organisations, inasmuch as the most interesting exhibits have been furnished by the foundries themselves and not the suppliers of foundry plant and material. At the inception of the International gathering, which closes on September 21, no official catalogues were available until last Saturday, and systematic inspection was essential to gain a full appreciation of the complete exhibition. The show is divided into three sections, incapable of bearing a separate appellation as there was a bit of everything in each. Outside in the open air, and in the centre of the Exhibition, Messrs. Bonvillain et Ronceray had erected a complete foundry, in which cupola-melted metal was poured into moulds made by a large range of mainly hydraulically operated machines. The stand is replete with sand-preparing plant, including the new projecting machine recently described in these columns.

Furnaces and Melting Appliances.

The foundry world is at the moment particularly interested in the question of better methods of melting light metals. A system using heavy oil was shown by Louis Hirsh & Cie, of 161, Avenue Gambetta, Bagnolet (Seine). They are supplied with two burners containing two compressed air parts, one for atomisation and the other for combustion, the oil passing through a specially designed shaped pipe, which eliminates any making up. A quite new design of electric furnace was being shown by the Soc. D'Etudes et de Constructions Metallurgiques, of 64, Rue La Boëtie, Paris (8).

It has a capacity of 250 kilos., and is engaged upon the melting of bronze. It is designed to maintain low zinc losses when melting brass by a combination of high voltage (200) and rotating arc. It is hoped to give the results obtained during the run of the exhibition in the near future.

"Russ" furnaces, made by Industrie Elektroofen, of Cologne, included electric heat treatment furnaces, an induction furnace for special steels and a core or small mould-drying stove. Portable stoves were shown by the French representatives of Oehm, which are now well known in Great Britain.

Moulding Machines.

Nothing radically new is being shown, but most of the well-known machines have incorporated some little refinement or other. Again, those claiming to effect deep draws have chosen really difficult patterns. Whilst they have been made still more automatic, for instance, the scraping off of the residual sand after jar-ramming and before finally squeezing has been effected for types 421 and 422 of the Osborn machine (handled in Britain by J. W. Jackman & Company, Limited, of Manchester).

Glaenzer and Perraud, of 18 and 20, Faubourg du Temple, Paris (11), show an interesting machine for moulding, without using a stripping plate, quite delicate types of castings. A rotating machine made by Construction Mecanique Duplex concern is designed for quantity production jobs such as cooking pots and pans, which carry large cores. Another type which presents several features of interest is Rosières-Bachon, made by the S. A. des Usines de Rosières, 6, Avenue de la Prefecture, Bourges (Cher), but is more for moulding shallow patterns in shallow boxes. The sand is rammed by the pressure of three continuously moving rollers. It is provided with six stripping gadgets coupled in series, and which replace one another at constant speed, forming what might be described as a "closed circuit." The first of the strippers receives the part of the pattern corresponding to the cope and a second to the drag and so on. Each part pattern is first provided with an empty box part when it passes a certain point. Then the stripper which carries it passes beneath a sand hopper which fills it. Then it passes an operator, who hand rams it, and it finally passes beneath the squeezing rollers. The automatic stripper then comes into operation, leaving the mould on an inclined plane, when the moulds are removed and the circuit is re-established.

German-made Tabor machines of the latest type are being shown. They are handled in Great Britain by Messrs. MacNab & Company, of London.

The Demmler core-making machine, which was favourably commented upon by the British visitors to the Detroit Exhibition last autumn, was new to most of the British visitors. It fills the core boxes by injecting sand by means of compressed air. It was shown by the Fenwick Frères, who handle the sand-slinger in France, the corresponding firm in Great Britain being the Foundry Plant and Machinery Company, of Glasgow.

There was a new type moulding machine, which incorporates the rapid injection of sand into the boxes, by the Badische Machinen Fabrik, of Durlach (represented by Ingrams in Great Britain). This machine utilises compressed air for the actual projection of the sand, which has been magnetically freed from iron scrap. It was critically examined by the British visitors, who will follow its industrial exploitation with interest.

A core-making machine shown by the Fonderie de Sens—Société d'Electricité Mors, Chemin-Neuf, Sens (Yonne), is provided with an efficient vibrator, whilst the stripping movement is well thought out.

(To be continued.)

International Committee of Foundry Technical Associations.

Following the closing sessions of the Foundry Congress, the members of the International Committee of Foundry Technical Associations met under the presidency of Mr. Paul Ropsy, President of the Belgian Foundrymen's Association.

After having adopted the minutes of the previous meeting, the Committee proceeded to elect the President and Vice-President of the International Committee for the year 1928. Dr. Siegfried Werner, President of the German Foundry Association of Dusseldorf, was elected President, and the Vice-Presidency was offered to the President, for the time being, of the American Foundrymen's Association, who will therefore become President in 1929. Mr. Delport, European representative of the American Foundrymen's Association, thanked the Committee for the honour which they had conferred upon his Association. The adhesion of the American Foundrymen's Association to the International Committee was confirmed.

Mr. J. M. Espana, speaking on behalf of the Spanish foundrymen, invited the foreign Associations to attend the Congress which will be held in Barcelona in April, 1928. The Congress will be followed by a tour, which will cover the most interesting districts of Spain from an industrial and also from a historical point of view.

Mr. Van Niekerken announced that the International Committee on Testing Materials would meet in Amsterdam during the week commencing September 12. It was announced that the International Committee would be represented by Professor Portevin (France), Professor Rabozet (Belgium) and a German representative.

Mr. Espana drew attention to the International meeting of the Technical Press which would be held in Berlin in October next, and Mr. Vanzetti issued an invitation to the Associations represented on the International Committee to attend the Conference which will be held in Italy in 1931.

Professor Pisek, President of the Czecho-Slovakian Foundrymen's Association, proposed that a technical dictionary of foundry terms in several languages should be prepared. It was decided that the question should be carefully considered under the direction of the President of the International Committee, and in the meantime members were invited to forward their suggestions to the President.

In closing the meeting the President, Mr. Ropsy, expressed the thanks of the Committee to Mr. Makemson, the Hon. Permanent Secretary, for the manner in which he had carried out his duties since the formation of the Committee.

At the conclusion of the meeting, the delegates were entertained to lunch by Mr. Ropsy, at the Palais des Expositions. Mr. Ropsy expressed his pleasure in having the opportunity of welcoming the delegates, and Dr. Siegfried Werner thanked Mr. Ropsy on behalf of the members.

The Feeding and Gating of Steel Castings.

By A. Rhydderch.

Introduction.

During the last few years very little literature has appeared in the technical Press dealing with the gating and feeding of steel castings, even though the steel-casting industry has assumed very considerable proportions. Furthermore, it is noticeable that whatever photographs of castings are shown, with the heads and gates attached, a discussion invariably ensues regarding the method employed in their production. This Paper is therefore prepared as an introduction to deal with some of the fundamental principles and considerations in the gating and feeding of steel castings. It is also obvious that the foundrymen disagree amongst themselves regarding the methods of producing clean and sound castings.

This point can also be verified during visits to various foundries with the methods of producing castings from a feeding and running point of view, when it will be seen that very seldom do foundries use the same type or size of gates, or the same type or size of feeding heads for the production of the same castings.

To a great extent in this country steel foundry practice has been based on and developed out of iron foundry and non-ferrous foundry practice, although there are very considerable differences in the behaviour of the metals. The conditions of a steel foundry are very much more severe when the high contraction, high shrinkage, and the fast rate of pouring are considered. Further, the skilled moulder is passing out of the industry and semi-skilled men using machines are gradually but surely being introduced, with the result that to produce sound and clean castings the matter of gating and feeding steel castings becomes of paramount importance.

In the past, and even often to-day it has been, and is the custom of many foundries, to allow the moulder to cut and fix his own gates and risers, with the result that very seldom two moulds of the same pattern are produced exactly alike. The result is that one often has the most irritating and exasperating experience of finding castings, which were once produced satisfactorily, now becoming a bugbear in the fettling and machine shops. The defects encountered in the production of steel castings are sufficiently numerous and mysterious without introducing unnecessary ones by this manner of allowing the size, location and shape of gates to vary, as well as any variation in the size and position of the feeding head, and that from this point of view alone it becomes a very important matter to fix, as far as possible, gates and feeders and chills on castings, so that at any future occasion the job can be satisfactorily produced in the light of past experience. In some foundries this procedure has been adopted to the extent that all castings being made are carefully logged with all the necessary data regarding these points. It is obvious that such a procedure will help very considerably in any investigation devoted to defects in castings.

It is extremely difficult to lay down any hard and fast rules for the production of steel castings, as the type and size are so varied that for the purpose of a discussion it is considered more advisable to discuss the general principles involved, in so far as the writer is concerned, and to do this it is suggested that the simplest method will be to consider the various points that come to one's mind when a pattern is inspected prior to going into the foundry for production. The first point to be considered is that every foundryman's ambition is to produce a perfectly clean and solid casting with the minimum amount of runners, risers, chills or brackets, as all these items have a very distinct bearing on the cost of the casting, but it is false economy to cut down risers or leave off chills or brackets, with the resulting defects which have to be repaired, if possible, in a welding shop. Taken generally, the size of a fettling and welding plant is a very good criterion to the efficiency of a foundry.

Although the points enumerated in this Paper may appear detailed and elaborate, still all these points must be considered in the production of any casting, and it rests with the man on the spot as to how many of them have to be adopted for the casting in question.

To deal with the question in particular it is proposed to follow the path of the metal from the time it leaves the ladle, or the shank, until the casting is made complete.

Runner Bushes.

The metal first enters the runner bush placed on the top of the moulding box. In many foundries it is the custom to cut the runner bush into the sand; in others the runner bushes are made by hand out of green sand and not dried. In other foundries, all runner bushes, even for the smallest work, are dried, and for larger work the runner bush is a very elaborate mould. The runner bush is a very important part of the casting, as this receives the full impact of the metal. If it is dirty or rough on the surface, due to poor workmanship, the result is invariably shown in the casting. Many a casting that has been carefully made has been ruined by the failure to appreciate the importance of a runner bush. For small and medium-sized work a plain runner bush serves the purpose, but for the larger work more elaborate bushes are required.

The Down Gate.

Having now allowed the metal to enter the runner bush it then flows down the down sand gate. Here, again, the same remarks apply regarding the advantages of a dry and green down sand gate. It is the custom of some foundries to use a core. So as to ensure no wash of metal on the larger work fireclay tubes are used, such as stopper sleeves, and in some foundries on the Continent special sleeves of various sizes are always carried in stock for particular work. The surfaces of some down gates are undoubtedly very rough, and it is considered to be a distinct advantage to make the down gate in small work with a brass or steel tube so that the surface of the gate can be made as smooth as possible. Where any rough pieces of wood are used the surfaces of the gate are invariably rough, and are easily washed.

Location of Gate.

We now come to the question of the advantages and disadvantages of pouring from the top or the bottom, or the joint. The advantages and disadvantages are as follows:

	Advantages.	Disadvantages.
Top Pouring	(I) Hot metal at top. (II) Not much waste metal. (III) Breaks up scum. (IV) Less tendency to secondary pipe.	(I) Erosion. (II) Splashings and spills.
Bottom Pouring	(I) Rising metal with clean surface. (II) Less erosion on moulds.	(I) Secondary pipe. (II) Freezing of runners. (III) Waste of metal. (IV) Tear in Casting. (V) Shrink in runner.
Joint Running	Hot metal but cracks.	

Both top and bottom pouring have a number of strong supporters, but as will be realised from the advantages and disadvantages already enumerated, both methods have considerable advantages and disadvantages. When the whole point is considered there is no doubt that top pouring, where it can be practised, is undoubtedly the better method for obtaining sound castings. That this can be done is evident by the production of large and heavy castings that are produced successfully by this method in some of the largest British foundries.

XUM

Slag and Dirt Traps.

Having decided on the method of pouring, the next question is whether it is necessary to employ any slag or dirt traps. In the case of top pouring it is undoubtedly an advantage to use what is commonly termed a sieve or a filter head. This takes away the dirt and pressure from the face of the mould, and in the case of bottom pouring, or even pouring from the lip, it acts as a slag trap. This method is being successfully used in quite a number of foundries in Britain and on the Continent for the production of green sand castings such as wheels, which are fairly extensively machined. It has also a point of economy in its favour, as against running from the bottom, which is practised on this type of job, in that the weight of the runner is saved. The smaller the holes can be made in the sieve head, and at the same time running the casting successfully, the more satisfactory are the results. For instance, in the making of a wheel with very thin and complicated arms, about 2 ft. dia., and weighing about 1 cwt., a runner bush 8½ in. dia., 4 in. deep, with eight holes of ⅜ in. dia., was used. In bottom running the question of a slag and dirt trap is equally important, and quite a number of methods are in use for this purpose. For instance in some cases where flat objects are being cast on the flat a long runner is used with ingates a few inches short of the end. The long runner undoubtedly acts as a filter, and the flow-past acts as a sump for any dirt or slag. In other instances a combination of sump and swirl gates is used. This portion of the gate must not be located too closely to the casting, otherwise there will be a tendency to develop a hot spot, with the resulting crack or shrinkage. The actual position of this part of the runner will obviously depend on the relative thickness of casting and runner.

Cleanliness of Machined Faces.

It will be accepted that to obtain clean faces on castings it is highly advantageous to arrange where possible that these faces are either cast down or vertically in a mould. Another point is that the farther away from a machined face that an in-gate can be placed, then the cleaner is that machined face likely to be. It is also preferable to locate an in-gate in the thinnest part of the mould where the casting is of irregular section, and of what can be described as a light casting; this allows the metal to cool off as it enters heavier sections, and tends to equalise the cooling.

Shape and Size of the In-gate.

The question of fluidity of the metal has a most important bearing on the shape and size of the gate. In addition, the size, section, and shape of the casting is a second point, and finally the speed of pouring. The tendency in steel foundry practice is to use gates very much larger than is actually necessary for the production of a satisfactory casting. This is probably due to the well-known fact of the higher temperature of steel, and also its comparative lack of fluidity when compared with cast iron, and what is more important, the lack of any satisfactory method of testing the actual fluidity of steel. In the open-hearth the fluidity is governed by the skill of the melter. The same remark applies to the converter process, but in the electric furnace one finds a rod test or a scumming test being used. Unfortunately, in the case of the electric furnace a satisfactory reading in the furnace itself does not always produce a very fluid metal. The reason being that fluidity in the electric furnace is not purely a function of temperature. Under certain conditions it is undoubtedly a function of temperature, but so far these conditions have not been rigorously determined, and in our present state of knowledge the question of obtaining a steel of a definite fluidity, or what can be better described as a definite mould filling capacity, is to a certain extent a matter of guess-work. In some malleable and grey iron foundries, and now in some steel foundries, a fluidity test is being used. This takes the form of the tests first proposed by Saito and Havashi, and subsequently modified by Remy and Cury. It is certainly proving its value in grey iron and malleable work, but so far no data has appeared regarding steel, and although some tests are being made at the present moment, it is too early yet to say whether it is likely to be of any use. If this method will prove, as it is quite possible it will do, that the fluidity can be definitely measured, then it should be of great assistance in enabling one to find a definite size of ingate and to ensure fewer mis-runs in castings.

Pouring Speeds.

The next point to consider is the speed of pouring various castings.

Some exceedingly interesting data has been collected regarding the pouring speeds for various types of castings. These curves have been established on quite a number of castings, and are being verified. It is very interesting to note that these points lie on a smooth curve. It is interesting to point out that a curve for the rate of pouring cast-iron castings recently published by Dietert in the A.F.A. shows the big difference between the pouring speeds in use at two foundries. Dietert has gone a step farther, and has actually calculated the gate area for various castings, and is now fixing definitely the size of the gate in the patternshop, so that a definite speed of pouring is obtained. Actually the speed of pouring is governed by the size of the in-gate, the fluidity of the metal, the direct head pressure, the dynamic pressure of pouring, and any back pressure in the mould. These factors have all to be examined and tested very carefully before we will be in a position to make some definite assurance regarding the size of gates to be used on steel castings.

To revert to the question of following the flow of metal, we had arrived at the point where the metal had reached the gate at the bottom of the down gate. We now come to probably the most important point in connection with gating, and that is the shape and size of the in-gate. It has already been stated that in steel, taken generally for thin and medium castings of irregular section, it is the best policy to allow the metal to enter at the thinnest point of the casting. We have now to decide the form or shape of this gate. It is necessary to decide whether one large gate or a number of small ones will best serve the purpose. In addition a large gate disturbs the thermal equilibrium of the part of the mould where it enters. It is likely to cause a great deal of wash and erosion, and by upsetting the thermo equilibrium, and by making the sand hot, and thereby retarding equal cooling of the casting, it will set up cracks. Whereas, by the use of a number of smaller runners these objections are removed.

The size of the gate must also be regulated by the average or medium pouring ability of the steel. It must not be based on the hottest steel, as very hot steel has many disadvantages. Neither must it be based on very cold steel. Where the gate enters in a horizontal direction is where it should be joined on to the mould with its narrowest point at the junction. The point is whether the last 1 or ½ in. should be splayed out so as to allow the metal to flow into the mould? One consideration that is often missed in the use of small runners is that although the total area of two, three or four small gates may be equal to that of one large gate, their ability to take fluid steel is very different, and if therefore smaller gates are substituted for one large one their total area must be greater than that of the one they are replacing. The relation between the total area of the in-gate and that of the down-gate is a point that is often discussed, and very frequently mis-run castings are obtained by a failure to observe this relationship. The area should be as nearly as possible the same as that of the down-gate. With a number of smaller runners it can be made distinctly larger, because the effective pouring area of a small gate is smaller than the effective area of a similar shaped larger gate, due to the greater chilling effect of the surface.

The size of the in-gate must be distinctly smaller than that of the casting. It is unfortunate that however careful one might be regarding the shape and size of in-gates, there is always the tendency to wash near the in-gate. As a precaution to avoid this, several devices have been used, such as nailing the mould, the use of dry-sand cores, and the use of very much stronger sands which will stand up better to the erosion of the steel.

Should castings be made with hot steel and small runners, or cold steel and large runners? Is the effect the same on the shrinkage? It is a very open point, and within limits better results are obtained with fairly hot steel and small runners, than with cold steel and large runners for small or medium castings. Is the same effect obtained by, first, fast pouring and then slowly finishing off as by a slower rate of pouring? The author believes that the best results are obtained by fast pouring and finishing off slowly, for the reason that continued slow pouring disturbs the equilibrium, whereas by fast pouring and then filling slowly a proper feeding effect is obtained.

Methods for Ensuring Solidity.

So far the precautions necessary to ensure cleanliness and avoid mis-runs have been discussed. Now it is necessary to consider how one can ensure the production of a casting perfectly free from any shrinkage holes. This is a difficult question to settle in many cases, but it is the desire of every foundryman, and various methods are used to ensure as far as possible that this is achieved—such as feeding heads, which are placed over the heaviest sections, chills internal and external, location of the runners so as to ensure cool metal entering the heavier sections, and hot metal on to the top of the casting. It is obvious that each casting is a problem in itself, and that no definite rules can be enunciated. The fact that a casting appears solid when examined in the fettling shop does not necessarily prove that this is so, and it is quite possible that deep-seated shrinks exist. Unfortunately, X-rays are not commercially available in the steel foundry yet for investigation purposes, and the only remedy that the foundryman has is to cut up an actual casting.

A great deal can be learnt, however, by considering the progress that has been made in the casting of ingots, and information can be obtained by consulting the various data that have been published on this particular question. It is only comparatively recently that the standardisation of the ingot moulds has been brought about, due to the work of Brearley, Howe, Stoughton, Brinell, and numerous other workers. A few years ago it was quite common to find similar shaped ingots being cast in different manners, with different pouring speeds, different sized heads, different temperatures of the mould, different sections of the mould; but now it is not nearly as common. The questions of temperature of steel, speed of pouring, the shape and size of the ingot mould, and its temperature have been very carefully investigated, and in all large steel works are very closely controlled. Undoubtedly this is more difficult to do in the case of foundry practice, but even jobbing foundries have a certain repetition of work from month to month or year to year, and if therefore all these points are carefully noted they should be of great assistance in the production of the same casting at subsequent periods. Furthermore, in view of the developments of alloy steel castings it becomes a question of paramount importance to ensure solidity as such castings require comparatively drastic and complex treatment to obtain the best physical properties, and if they are unsound it is practically certain that cracks or fissures will develop during these treatments.

Furthermore, Howe and Stoughton gave a very interesting summary on this question, and they pointed out that shrinkage can be decreased by casting, first, in wide ingots; second, in sand-lined moulds; third, using top pouring; fourth, using slow pouring; fifth, casting large end up; sixth, by the use of a sink head on top.

This summary shows that thin sections are more prone to develop shrinkage than heavier ones, and secondly, wherever possible the heavier sections should always be cast in the top of the mould, so that they can be fed with a sink head; this allows the metal to feed by gravity and by hydrostatic pressure. Thirdly, the rate and manner of pouring controls solidity.

The Shape and Size of the Head.

Here again a great deal can be learnt from an examination of the method of making ingots where the inverted frustum of a cone has become standarised practice. This is equally as efficient as a cylindrical head, or a head that can be described as "vertical." This, of course, applies to the larger heads only, and not to heads that are used on the smaller castings. Very often with small and medium castings it is necessary to make the heads very much larger than the object that is being fed, such as the flange of a wheel, or the flange of a valve.

No definite figures can be given as to the actual size of heads, and they can only be decided on the spot in the light of previous experience. A tour round steel foundries will confirm this point, when it will be observed that smaller castings are fed by very different sized heads, also current technical journals very often show photographs of castings being made by various foundries, with the heads and runners in position. In a recent example the author saw photographs of wheel centres made in a German foundry. These were fed by heads much larger than anything he had ever seen in this country, or in France and Belgium. Whereas the valve castings that were shown were fed by comparatively small heads. It is possible, of course, that some other means had been used to ensure solidity, and it may also be possible that different steel was being used. But even bearing these points in mind the differences were far greater than one would have imagined. It is not an uncommon experience for some castings to require 150 per cent. of head to ensure solidity. It is necessary to remember that fluid steel behaves according to the hydrostatic laws, that is, the metal finds its own level and exerts pressure according to depth only, and not according to section, that is, a long narrow head exerts just as much pressure on the mould as a very wide head of the same height. This is a point that is frequently missed in making alterations to a head that has not proved satisfactory. This point will be dealt with later.

Undoubtedly the idea of every foundryman is to use the minimum-sized head so as to produce solidity. Very often heads that are used on general engineering castings yield apparently sound castings, but if these castings were subjected to hydraulic or steam tests they would show porosity, due to a looseness of structure. The result is that castings subjected to steam or water pressure require larger and higher heads to promote a denser structure. Very often this is accomplished by altering the composition of the steel.

Coming now to the detailed discussion of the shape of the heads it is found that various ideas are extant. For instance, cylindrical type of head, the frustum of a cone, or thirdly the inverted frustum of a cone. These three types being simply a continuation of the casting, and finally it is found that all the above types are used, but a necked head is used to joint the casting to the feeding head proper.

Regarding the necked head, its advantages are that it saves a certain amount of metal, and can be removed very much quicker in the fettling shop. It can only be of service, however, where the head itself is very large, so as to ensure the neck not freezing before the head. It is very doubtful, however, whether the saving of metal so obtained or the question of the gain of time in removing the head makes it worth while. The trumpet-type of head, or what has been described as the frustum of a cone, is not an economical head and involves a waste of metal. In addition the hottest part required for feeding the casting is in the wrong place. The inverted type is now universally used on ingots, and on the larger heads necessary for steel castings.

Economy in Heads.

In order to cut down the size of the head to a minimum various devices have been used from time to time, the idea being to keep the head fluid as long as possible so that the metal in the head all becomes available for feeding the casting. The most common and popular methods that have been practised are:—(1) To use a heated refractory head; (2) to heat the head with an electric arc; and (3) the Hadfield method, which consists of covering the head with a layer of slag, then a layer of charcoal, and blowing air on to this charcoal.

All these methods are efficient and have been used very successfully in various foundries. In

XUM

castings other methods have been used so as to arrange for hot metal to enter the head last, either by a connecting runner or even by transferring the ladle to filling up the heads when the metal has reached the neck.

Another very common instance is that of wheel centres and gear blanks. The first method is to cast these on the flat with a large ring head round the boss, with or without smaller heads at the junctions of the arms. An alternative is to cast these with the ring head round the boss, with chills at the junctions of the arms, and still a further method is to turn the wheels on end and cast with a large taper head on the flange and a chilled core through the boss. This last method can be used successfully on disc wheels, and on wheels where the boss is relatively small in section, but in wheels with arms it is impossible to guarantee the casting sound at the junction of the arm.

Alternatives to Direct Feeding.

It is now necessary to consider the parts of the casting that cannot be so located in a mould so as to be directly fed by a feeding head, as in the case of a magnet frame with internal bosses, or a long pinion sleeve casting. It is obvious that such castings cannot be made solid by the use of feeding heads alone, and that some other method must be adopted. In such cases resort must be made to the use of external or internal chills. The function of the chill is to accelerate the cooling of the particular part of the casting where it is applied, and so reduce its effective thickness to something comparable with that of the remainder of the casting. It can be seen from this that it is possible to over-chill a casting, and thereby drive the shrink into some other part. But if the thickness of the chill be adjusted, then this will not happen. It has been frequently asserted that a chill simply drives the shrink to some other part of the casting where it is either out of sight or harmless, but this is definitely not the case. All the chill does, when properly applied, is to reduce the effective thickness of the metal in the neighbourhood of the chill.

Internal chills are such that a rod approximately quarter the diameter of the section requiring chilling will ensure a perfectly sound section. In the case of a spiral the volume of the spiral inserted can often be made less than this owing to the greater surface of the spiral and therefore its greater chilling action.

For external chills a very rough rule is that the maximum section of the chill should be approximately the same as that part of the casting being chilled, tapering off a thickness sufficiently great not to stick on to the casting. Another form of internal chill that is frequently used is the spiral form. Such spirals are used in small medium or even large bosses, and also in flanges and radii that cannot be fed by any other means. The important point to bear in mind here is that the thickness of the wire must not be too great, and that the spirals must be opened or closed according to the mass of metal surrounding it. In no case should they be used with a spiral completely closed as is frequently observed.

Unfortunately chills possess many disadvantages. Long chills should never be used, as they tend to buckle: the result is that a series of short chills must be used to produce the same effect. This means a joint with a small piece of sand in between the chills. This results in a hot spot, and will either show a crack or a blow. To overcome this, either a nail must be used, or an internal chill used as a tie-bar.

When chills are left either in green-sand or skin-dried moulds, or even warm moulds, they tend to condense the moisture, with the result that a blow develops during casting. This, of course, can only be obviated by arranging for all such work to be cast as quickly as possible after closing. There is no doubt that as the narrower, that is, the lighter sections of steel castings, are more prone to develop shrinkage than the thicker sections, chills must be used far more frequently on the lighter classes of work.

The Burning-on of Chills.

The safest, simplest, and most efficient method to avoid this is to increase the thickness of the chills, and that there is no doubt that a coating of graphite or rubbing the chills in graphite does help to prevent any burning on, and this method is frequently adopted. Where wire is being used it is always advantageous to use copperised wire, as this always ensures the surface being free of any rust. Radii in small and medium-sized castings, particularly where the fillets are sharp, have either to be nailed or chilled, and here again the same rule applies—that the thickness of the chill must be approximately the same as that of the thickness of the metal, otherwise the chills will burn on.

The author realises that the opinions expressed in this Paper are in some cases very elaborate and indefinite, but they represent the thoughts that flash through the average foundryman's mind when he first sees a pattern which has to go into the foundry for production.

As previously mentioned, in some cases the castings can be turned out very satisfactorily with a minimum amount of trouble. In others, even with the most elaborate precautions such as have been enumerated in this Paper, the castings on machining are far from satisfactory, and it is then that all the means and methods known must be tried to ensure a perfect casting.

It is hoped that with the progress of time that more definite data will become available, and that a more frequent and free exchange of ideas will take place on these topics so that the practice of producing certain castings can be standardised.

There is no doubt that to gain and maintain the confidence of the engineer perfect castings must be produced so as to enable them to cut down their factor of safety, and to cut down expenses, machining losses due to the castings showing up defective when a considerable amount of work has already been performed upon them. It is also probable that by close attention to all these details and by the gaining of his confidence the foundryman will eventually be able to co-operate with the engineer in the production of designs that will enable the foundry to guarantee a clean, sound casting.

A Note on Pulleys.

By J. M.

Pulleys and belting do not often get the consideration in patternshops that they require for efficient operation. A pulley will be allowed to run out of alignment and belts are run too tight or too slack. The writer is of opinion that the efficiency of a patternshop depends to a large extent on the machinery equipment being in perfect condition, but the maximum of efficiency cannot be obtained from planers, saws or other machines unless shafts, counter shafts, pulleys and belts are in first-class condition.

At one time, square bars of shafting were in use, the same being turned round where the bearings were located. In those days they built the wood pulleys in sections, nailed them together, started the shafting and turned up the outside of the wood pulley in place. One wonders if such pulleys were as effective as those in use to-day. Thirty years ago the wood pulley commanded the largest sale for line-shaft purposes, then came the steel-rim split cast-iron pulley, which had quite a considerable sale. Then, later, an all-steel pulley was brought on the market with interchangeable bushings. One expert expresses the opinion that to-day there are more steel pulleys used than any other type. There is also a split cast-iron pulley made with interchangeable bushings which is in use. In some pattern shops wood pulleys are very popular to-day. While much has been written about the belt friction or adhesion of the different kinds of pulleys it is generally conceded by all that the wood pulley will deliver the most belt power; the steel pulley comes next and then the cast-iron pulley. Cast-iron pulleys are in general use in countershafts and machines as a turned cast-iron pulley runs truer than any other make. The shafts usually run faster than line-shaft pulleys. Is there any other engineering subject on which more has been written than on the loose pulley. It is not such a serious problem in pattern shops as in some workshops however.

Moulders' Mishaps.

By J. E. P.

Very few people have the courage, or honesty, to acknowledge their mishaps or failures, or even to recount their experiences in such matters. So far as the moulders are concerned they will, in far too many cases, strive to prove that the cause of the failure, or waster, was the patternmaker, the coremaker, the sand, the labourer, the metal, not themselves, or they will try to hide the waster as hastily as possible. "Out of sight, out of mind" is a well-known phrase in the foundry.

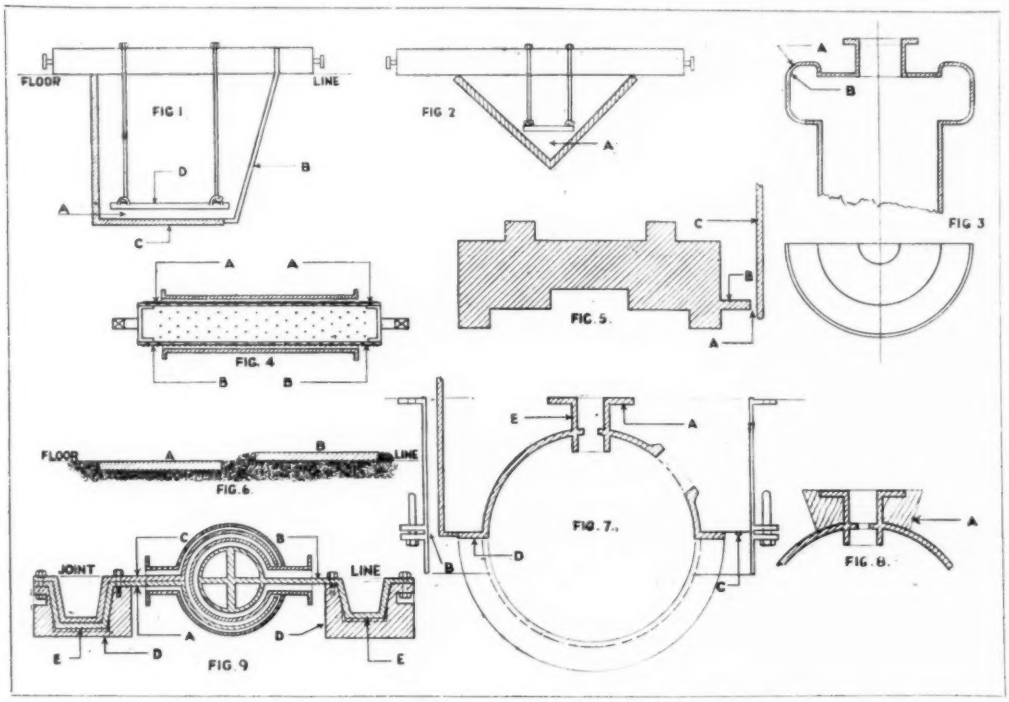
The proprietors, manager, and superintendents are not above reproach in this matter, for by the unreasonable attitude which they take of all wasters they create in the moulder a desire to keep all shortcomings and failures from them.

Of course this attitude is wrong in both cases. If the employer understood the art of moulding, and all its attendant difficulties, and extended to the moulders sympathy, instead of treating them in a manner calculated to engender fear, he would very soon find a marked improvement in all his moulders, which improvement would reflect in all their work. Fear is a very undesirable characteristic in a moulder, fear engenders nervousness, and it has been said: "Better a drunken moulder than a nervous one." Nervous moulders make more wasters than drunken moulders.

Fig. 1 is a sketch of a large angle plate, weighing about 3½ tons, which was undertaken by a jobbing foundry, although the foundry was ill-equipped to produce such a casting. However, it was taken in hand and moulded as Fig 1. It is rather difficult to understand why it was so moulded, one would have thought that the better way would have been as is shown in Fig. 2. There would have been less depth of hole to dig, less weight of lifting plate D, and far less weight of cod and top box to lift and the crane to carry. The lifting plate D or grid was kept up from the bottom plate of the casting, and the space between at A was hooked in the usual manner. B shows the runner down the joint. When the top part was rammed up and the chains fixed to it for lifting, it was discovered that the jib crane could not lift it. As the jib had strained down about 6 in., the weight was released at once and the jib of the crane was propped up from the floor. This enabled the top part box with the heavy cod to be lifted from the bottom part of the mould quite successfully, but having lifted it up, it was quite impossible to move it, so it had to be propped up just where it hung and finished overhead. This is always a long and tedious operation, necessitating the moulder lying on his back on the floor and working up the surface of the mould from that position.

Had this job been moulded as at Fig. 2 it could have been turned over and finished in the ordinary way.

When the top part was finished and blacked, the drawing of the pattern out presented another difficulty, as the ordinary mechanical means could not be applied on account of the obstruction of the top part; therefore the pattern had to be withdrawn inch by inch and propped up at various stages. When it was fairly well out of the mould it could not be taken away by reason of the props, upon which rested the top part, preventing a free passage; so with screwdriver, hammer and chisel the pattern was dismantled and taken out in pieces. Then the mould was finished, blacked, dried and closed by the jib of the crane being propped up as before, and poured quite successfully.



In removing the casting from the sand the next day not much difficulty was experienced, as all bolts were released and the top box-part lifted off without the cod, tackle or casting. All the sand, grids, bars, etc., were dug out and the casting lifted up. Upon examination, a hole about 12 in. square was discovered in the bottom plate at C, Fig. 1. The moulder had forgotten to remove the piece of wood which he had placed in the mould to stand upon while he finished the mould. Thus it was cast in, obviously a silly mishap; yet loose pieces of patterns, facings, bosses, lugs, etc., have been left in the moulds. To obviate this class of mishap, all loose pieces should be painted a brilliant red, or any other colour which is in direct contrast to the black sand. To quote the late Mr. W. E. Gladstone, "Everything should be done to make it easy for a man to do right, and everything be done to make it hard for a man to do wrong." Patternmakers please note this.

Accident with a Turbine Casting.

Fig. 3 shows the joint section of a turbine casing. This job was made in loam, and struck with strickles in the usual manner. A very strong core iron or lifting plate was first bedded on to a thin layer of loam. Then the brick structure was built up on this. For the purpose of this article there is no need to describe in detail how this mould was made. When the top plate, binders, etc., were removed together with the brickwork of the top part of the cope, and the casting brought into view, it was seen to be cracked at A, Fig. 3. The casting was lifted off and the brickwork was examined, and was found to be of much too solid a character at B, thereby allowing no provision for contraction. At these corners, layers and courses of loam bricks should have been worked in with the ordinary bricks, and this the moulder had forgotten to do. Moulds of this description must be built sufficiently strong and rigid to withstand the liquid pressure of the metal at the time of pouring; yet they must also be built sufficiently elastic to permit the solid contraction. Such a mistake as this costs a firm very large sums.

Fig. 4 is a sectional sketch of a plain, straight pipe, showing the core barrel with straw rope upon it. The pipe was about 10 ft. long and 2ft. dia., flanged at each end. The mishap occurred in this case in making the core. The straw rope was burned, thereby weakening the loam, which gave way under the pressure of metal, allowing the metal to get through into the barrel and out at the ends. In some cases too much straw rope is used; in others, the straw rope itself is too loosely spun.

A A, Fig. 4, shows the usual method of winding straw rope upon the barrel. It will be seen to be very closely wound, and no loam on the barrel before the straw rope was put on. This method is incorrect, as it frequently happens in drying the core the straw rope becomes burnt, this weakening the whole structure. The better way is to wind the straw rope on the barrel, which has previously had a smearing of loam upon it, and then keep the strands of rope a little apart, as at B, Fig. 4, so that the loam gets through into the barrel. This, as will readily be seen, builds up a good solid core, and at the same time allowing plenty of rope space for the gases to pass through.

It must never be forgotten that while straw or wood rope provides a means to hold the loam on the barrel and for the gas to escape by, yet it also creates gas in such large volume as to be decidedly detrimental to the casting, unless it is handled in the proper way.

A "Non-Starter" Runner.

Fig. 5 shows sketch in section of plain block. It was rammed up in the floor and run at the bottom. B shows the loose runner pattern to form the gate, but, unfortunately, during the ramming-up process the down stick C, Fig. 5, was rammed away from the gate stick B, so that it became disconnected by sand being rammed between them, as at A, and as the gate stick was drawn out into the mould after the pattern had been withdrawn, the obstruction A could not be easily seen. Thus at the time of pouring the metal could not enter the mould, but only filled the down runner C. The mould was carefully opened the next day and the runner removed, the sand re-wetted, and the sticks pattern put in and re-rammed. Care was taken to ensure the down stick C was connected with the gate stick B. This class of mishap is common to all foundries. Whilst they cannot be classed as wasters, yet they sometimes make a bad mess of the moulds, if not entirely spoiling them.

Fig. 6 shows how open-sand plates are made. This one was about 14 ft. in dia. and 5 in. thick. It was cast on a Saturday morning. On Monday morning the men discovered the plate broken in two pieces. The moulder had covered it with corrugated sheet-iron and kept them up from the casting about 12 in. The reason for this mishap is not difficult to find. The top surface of the casting being exposed to the cold air, while the bottom surface was not, unequal contraction was set up. All open-sand plates must be covered with sand to the depth of about 6 in. Fine dry sand is first sifted on the surface of the casting followed by floor sand sprinkled carefully so as not to distort the surface of the casting.

It is curious that sand moulders seldom make an open-sand plate without it scabbing, but the loam moulder makes them without scabs. A sand moulder always make open-sand plates below the floor line (A, Fig. 6) and invariably much too hard on the surface of the mould, whilst the loam moulder always makes his plates above the floor line and the surface of the mould much softer, so that all the gases readily escape. The author has yet to see an open-sand plate seal which has been made by a loam moulder.

How a Valve Cover Should be Made.

Fig. 7 is a cover of a valve and not very difficult in so far as moulding is concerned, yet when the first casting was turned out, the top flange (A, Fig. 7)—the pattern of which was loose—was not square with the bottom flange D, as the body of the pattern was rammed up covered, there was only the recess in the top of the branch E by which to locate the top flange, so it was easy for the moulder to go wrong. The safe way to avoid this mishap is to have the top flange A fixed on to the body of the pattern and a block print as at A, Fig. 8. The core is very easily made and fixed into the mould, and always gives good results.

Another mishap to this casting was the metal running out at B, Fig. 7. The moulder had not sealed the joint. The sure method to adopt to prevent running out when castings are near the joint of the moulding box is to cut a channel in the joint of the mould as at C, Fig. 7, and fill this channel with a mixture of oil and blacking, using rather more filling than the channel will hold, so that when the cope or middle part box is lowered on to the bottom part box, this filling will be squeezed down and seal the joint completely. The use of oil and blacking for this purpose will give far more satisfactory results than a loam stopping, which is always risky as the heat of the metal will generate steam from the wet loam, and sometimes blow the loam stopping away from the joint and allow the metal to run out. This will never happen if oil and blacking is used. In cases of smaller work some wet floor sand is rubbed into the joints of the moulding boss from the outside.

Globe Valves Spoilt by Floating Cores.

Fig. 9 shows a cross section of a double globe valve. Only those parts are here shown which will serve to illustrate the points in question, as the pattern was made it was not possible to mould from it without the use of studs and chaplets, and as the packing of the grains or chaplets is generally one of the last operations to a mould, and there is always a mild excitement at such times, caused by the powers that be shouting out "the metal will be ready before the mould." Small wonder is it that at such times and in such circumstances, that something is forgotten. In this case the moulder forgot to pack the top grain, and so all the cores floated. The next casting was better so far as packing the chaplets was concerned, but when the casting was put under test it leaked badly round the studs and chaplets. The Government then decided that this casting had to be made without studs or chaplets. Fig. 9 will show the expensive method of securing a good sound casting. Special core irons were made very strong so as to resist the upward thrust of the metal or floating of the cores, or any movement whatsoever at the time of pouring.

The blocks D, Fig. 9, were square and machined on the joints and in the sockets, but the bottom was clear so that no machining was required there. A clearance was left at E.E., then the bottom half of the belt core iron A was made and machined and fitted, and so on, with the centre core iron B and the top half of the belt core iron C. The pattern was made with spigot prints at the end to give the correct location of cores as the foundation blocks were rammed up upon the spigot prints. The corebox was so made to give a sure guide for the core irons. A trial trip was run before the cores were made. A dummy half of mould was made, and core irons tried in, slight errors were corrected, then the mould and cores were made. An entirely satisfactory casting was produced. This goes to prove the excellent ability of the moulder in turning out such a fine casting without studs or chaplets.

Some Aspects of Cast Iron as an Engineering Material.

By W. ROLAND NEEDHAM.

Iron castings are relatively cheap, they are widely used, and they cast with relative ease and simplicity. The casting of steel is much more costly, and is a highly involved and complicated business. It is true that the moulder possesses an astounding and almost uncanny facility for devising expedients whereby the initial casting strains are kept within surprisingly narrow limits. But, while steel castings often severely tax this versatility on the part of the moulder, and indeed demand a highly-specialised craftsmanship, iron castings are usually amenable to ordinary treatment by ordinary workers.

The products of the foundry, however, reflect the excellence, or otherwise, upon the mannal side, notably of too quite distinct services. Not only the good offices of the moulder enter into the reckoning, those of the furnacemen have also and equally to be considered. Nor is that all The quality of the pig used, also the quality of other raw material (from the founder's standpoint) are of real importance. Further, the vital middle-work, whereby the molten metal is delivered to the mould, is likewise a factor of the greatest significance. It has to be remembered, too, that each of these related services must not only function well *per se*, all must dovetail effectively and efficiently ere really satisfactory and consistent results may be confidently anticipated.

An Engineering Preference for C.I.

Although there are many obvious advantages in using the cheaper and commoner material, engineers often look askance at cast iron where considerations of strength or stiffness enter appreciably into the reckoning. Perhaps a notable exception (particularly in the U.S.A.) is such a key component as the upper bracket which supports the entire rotors and hydraulic thrusts of large vertical water wheel hydro-electric plant. Here stiffness, rather than strength, is mostly at issue. Accordingly, the section chosen must be inherently strong. Thus it is fairly common practice to cast the bracket in iron rather than steel, using a section which is relatively but little deeper than stiffness requirements would dictate for the costlier material. In general, however, it is undoubtedly the fact that, despite the far greater difficulty of casting and, in consequence, the much greater call upon the ingenuity of the moulder, cast steel is far more reliable in its physical characteristics. It is not only many times stronger than cast iron in tension, its outstanding superiority is the remarkably consistent character of its mechanical properties. Given the particular specification, close and regular results can be, and in the vast majority of cases are, normally obtained. Unfortunately much less must be affirmed with regard to cast iron. It is well known that many manufacturers of repute will not knowingly subject cast iron to tensile stresses which under continuous service conditions exceed 1.5 tons per sq. in. It ought to be readily possible for the most conservative engineer to double these stresses at least, and yet be able to sleep in comfort. Ere this can be generally accepted, however, much has still to be accomplished. The position of the metal itself has to become more definitely established—in a word, stabilised. Now-a-days a designer often has largely to rely upon a skilful marshalling of the elements of the cross sections, an adroit adjustment of the neutral axes. The disparity between compressive and tensile strengths will probably always be such as to render this expedient requisite upon occasion. At the same time symmetry should be more closely attainable. Much of the uncertainty about the material is due to the fact that research in cast iron is still in its infancy. Steel, on the other hand, is well grown and adolescent, if not mature. Once iron founders realise the immense importance to engineers of turning out reliable, consistent castings, and make a definite bid for improvement in the metal, a great step forward will have been taken. Much *border line* work could certainly be captured for the commoner material if those responsible for the foundry products would learn to follow the example set them by progressive foundrymen in the steel industry.

It is indeed high time that those pioneers undertaking research in cast iron, for the very laudable object of improving its quality and reliability, and above all, of placing it upon a scientific and assured basis, should receive the moral encouragement and financial aid the great and intrinsic importance of the subject warrants. Reference may here be made to an arresting healthily provocative outburst by Mr. Horace J. Young, in a Paper read before the Diesel Engine Users' Association.* The gravamen of his charge was that all except a small minority of British iron founders are unable to produce castings which shall satisfy a reasonably stringent specification. He wants material which may be *guaranteed* to stand up to severe service conditions, such, for instance, as are met with in the construction and operation of the Diesel engine. He is constructive as well as destructive in his criticism. The plea that more and better-paid metallurgists be taken into commercial employ, and that each foundry of note should have its own laboratory, merits serious consideration. Less welcome was his somewhat cavalierly reference to the methodical procedure of scientific investigation, where problems are attacked in detail, and results verified, factor by factor, in sequence. Such meticulous attention to detail, slow and protracted though it be, has been found time and again to be the only sure way of building upon secure foundations and erecting a substantial super-structure. Introduce, in the initial stages, several impurities, instead of one at a time, and it is practically impossible to analyse and interpret the results obtained. Knowledge of the history of steel and of certain leading non-ferrous alloys would here prove an admirable corrective. This is not a case for quick results—the apparently spectacular short cut is a delusion and a snare. In this instance the long way round is probably the quickest, because the only way home. Dr. Walter Rosenhain, F.R.S., in a popular article dealing with the history of steel, pointed out how the mistaken but natural impatience after practical results, actually threw back progress in steel manufacture many years. He showed that in the long run it was found necessary, inevitably, to accept the tedium of the laborious synthetic method. From that time, however, success has been assured and progressive. Now the same process is at work, and is at the present time well under weigh in the case of cast iron also. Mr. Young might with advantage have mentioned, indeed emphasised, that most significant fact. His timely and powerful plea would have lost nothing thereby. As instancing the potentialities which loom ahead, attention may be directed to what awaits the commercial exploitation of the low temperature carbonisation process. Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research, recently pointed out that once cast iron retorts can be introduced, upon a commercial scale, capable of resisting successfully and consistently the severe temperature conditions involved, the future is rose-tinted for the iron founder. He predicted that work to the tune of some twenty-five millions sterling should then be available for the industry. That is an objective for research. It is gratifying to know that the quest is proceeding, and that two experimental retorts, in good quality ordinary gray cast iron, have been practically in continuous use for twelve months.† Both retorts at the end of the period showed signs of bulging, but not so as to preclude their continued working. Now, with the aid of the Cast Iron Research Association, a new design is being prepared in a special metal.

The valuable work done, and the results obtained, in cast-iron development and research are of great value to all iron founders, not least to those in a small way of business. Though in general unable to maintain independent laboratories of their own, much of this handicap is definitely removable. Members of the Cast Iron Research Association are freemen to the discoveries made, and to the data available. They can thus utilise the knowledge gained and improve their methods accordingly.

---

* "A Note upon the Obligation of the Iron Founder to the Diesel Engine Users," October 15, 1926.

† Report by Dr. C. Lander, Director of Fuel Research, and Capt. J. F. Shaw, Chief Engineer, Fuel Research Station. Dept. of Scientific and Industrial Research, Fuel Research Technical Paper No. 17. H.M. Stationery Office (6d. net).

Brass Foundry Costing.

By S. Howard Withey, F.C.I.

The chief object of costing is to ascertain the actual cost of output, but the indirect advantages should not be overlooked, as these are many and varied. A good and appropriate costing system, for instance, enables selling prices to be fixed and determined with greater certainty; a check on stores is systematically afforded; waste and leakages are reduced to a minimum, and detected in time to prevent serious consequences; slack workers are sooner or later exposed; useful comparisons between one year and another, or between one period and another, can be made, and so on.

When the system of costing is being drafted, it should always be borne in mind that the books are the servant of the foundry, so to speak, which is another way of saying that the size of the business must be taken into account, as also must the nature of the particular work performed, and any special circumstances which may surround the various processes. Any system which has the effect of unduly taxing the employees by necessitating the constant filling up of many forms will most probably prove to be inefficient in practice, and should therefore be avoided.

The chief difficulty surrounding the institution of a system of costing for a brass foundry consists of the fact that the system will, in many cases, have to be as simple as possible, so that only a small staff will be required to operate it. If possible, therefore, the methods adopted should not necessitate the creation of a separate costing department, but should enable material and labour records to be collected in such a way as to ascertain the prime cost, with an appropriate interlocking system whereby the cost accounts may be reconciled with the ordinary books of account at least once every year.

the fact that small quantities of certain alloys have to be melted down in a special crucible.

Raw Material Costs.

Then again, the value of the material in the castings may be twice as great as the cost of the direct labour involved in the moulding, and where many different alloys are required for the castings, varying in composition and in value, any "average" cost of metal, such as may usefully be used in an iron foundry, would be very misleading. Unless the number of patterns and alloys used is really small, it will usually be necessary to adopt standard costs in order to find the value of the material in a casting, but such standards must necessarily be standards of quantity, and not of price, and must be easily adjustable, as the prices of the different metals in the alloys constantly vary. The very smallness of the castings also renders the marshalling of labour costs difficult. If the men are engaged on, say, machine moulding, or on any kind of repetition work, their time can generally be booked. When, however, a considerable number of moulders are engaged on jobbing work, and making from six to ten different castings in one box, the labour costs form an interesting subject, and present a rather difficult problem. Standards may then also have to be used.

The class of castings made differ, of course, in the case of different brass foundries. There is the jobbing foundry, doing both heavy and light work, the foundry doing both repetition and jobbing work, and the foundry doing a specialised class of work, such as valves, taps, heavy bearings, etc. In the jobbing shop, some moulders may be making light castings easy to make, but a heavy casting which is intricate to mould will often take a much longer time than usual.

The reliable allocation of wages on a time basis is impossible. This applies also to core making and fettling. Shop-process wages should be

Consecutive No. .....

COST SHEET—Week Ended.....1927.

CASTINGS.

	Class A. Copper or Bronze			Class B. Yellow Brass			Class C. Ordinary Brass			Class D. Gun Metal		
METALS.—Net Weight @ Cost Price.												
.....lbs. .. @ .....per lb. Charge to Class A												
.....lbs. .. @ ..... ,, ,, B												
.....lbs. .. @ ..... ,, ,, C												
.....lbs. .. @ ..... ,, ,, D												
.....lbs. .. @ ..... ,, ,, ..												
lbs. Total net weight.												
WAGES.—Moulders, Coremakers, Fettlers, etc. (Allocate by weight to each class, determined by dividing the total wages by total net weight and multiplying by class weights.)												
FOREMEN, etc.,—ditto.												
FUEL (total net weight multiplied by class weights).												
CRUCIBLE, SAND, and SUNDRIES.												
COST (total net weight multiplied by class weights). ..												
Establishment and Administrative Charges												
Total Cost												

A system which is suitable for an iron foundry will probably be of little use for adoption in a brass foundry. Brass castings are much more valuable than iron castings, for they contain copper, and consequently it will be necessary to guard against wastage and spillage to a much greater extent. In all cases the wastage should be most carefully watched through the medium of the costs.

Another important factor is the loss on melting. This loss consists of the difference between the weight of the metal charged into the furnace, and the weight of the molten metal obtained, and varies very considerably with the alloy. Sometimes melting losses of between twelve and twenty per cent. are sustained, due for the most part to

allocated on the basis of weight, as also should the expenses, except in the case of light castings by means of a moulding machine, when a unit could be employed as the basis.

A weekly cost sheet as shown above is very useful in the case of a jobbing foundry doing heavy work, the cost of material, wages, etc., being agreed with the ordinary books of account, and for the purpose of indicating the method of drawing up such a cost sheet, the following outline is given as illustrating the principles in operation where heavy castings of copper or bronze, yellow brass, ordinary brass, and gun-metal brass, are made:—

The stores department will make reliable records

of the weights of crucible charges. When finished, all castings will be weighed, and all runners and defective castings sent to the stores as scrap. Before putting into the furnace, the weight of the crucible charge, *i.e*, after deducting the weight of runners and defective castings, will give the net weight for entry on the weekly cost sheet, making allowance for the loss in skimming the ashes and dirt, and spillage losses. The wages of moulders, core makers, fettlers, etc., will be obtained from the weekly wages sheets, and in this connection it is better to introduce mechanical means of one kind or another for the checking of workers' time, which could be supported by daily dockets kept by each worker, upon which will be recorded the actual time spent upon the various jobs. Where possible, the charges under the heading of crucible, coke, sand, and sundries, should be shown at actual cost, and for this purpose the figures for the previous year could be taken, and the amount charged on the basis of weight, the net weight of the previous year's crucible charges giving the cost per lb. for tabulation on the weekly cost sheet. This method will also be adopted for ascertaining establishment charges, depreciation, etc., but will naturally call for careful consideration, particularly in those cases where the output is large.

The direct expenses may consist of the following:—(1) Rent of foundry, rates and taxes; (2) insurance of foundry; (3) lighting, heating, power, gas, water and fuel; (4) royalties, in the case of minerals only; (5) patent fees, if the particular article is being made under a patent; (6) "unproductive" wages and salaries, including those paid to time-keepers, store-keepers, watchmen, superintendents, managers, foundry clerks, foremen, enginemen, etc.; and (7) repairs, renewals, and maintenance of machinery, plant, moulds, tools, implements, furnaces, fixtures, etc. These charges could be costed on the basis of the figures for the previous month, although most of them should be based on weight and on the figures for the previous full year.

A system of requisition dockets should be employed by each department, these forms giving the job number or foundry order number, the quantity and description of the material required, signed by the employee in each case, and countersigned by the foreman. Upon supplying the material, the store-keeper should retain the requisition, and should enter the details in the stores ledger at once.

Pattern Making and Foundry Costs.

By J. M.

To keep down production costs the policy is sometimes adopted of making "cheap" patterns. This is justifiable up to a point, but, unfortunately, proper discrimination is not always shown, and it is not sufficiently realised that a cheap pattern need not mean a bad pattern. A skeleton pattern is usually a cheaper pattern than one built solid, but it may actually cost more to construct and it will invariably entail more labour in the foundry. In some districts skeleton patterns are more common than in others, and, in some shops, even when a number of castings are wanted, a skeleton pattern will be made when the first cost of a really good pattern would soon be recovered in the foundry. On the other hand, the writer knows of large pattern-shops where a one-off pipe pattern of large diameter would be made solid. When the foundry makes a pattern it is seldom that the wrong type of pattern is made. After all, it is castings that are required, and this is too often forgotten when the construction of a pattern is started. For efficient and economical casting production there must be complete co-operation between foundryman and patternmaker, and firms should make sure that the work is so arranged as to get the most satisfactory results. It is purely a question of planning. Broadly speaking, there are three types of pattern construction—solid work, skeleton work, and sweeping boards—by which sand patterns are made. When a considerable quantity of castings are wanted, the pattern with few loose parts is best, and, although cores are not always advisable, it is often cheaper to core off undercut parts than to take them away in drawbacks. It is not proposed, however, to discuss the relative merits of cores and drawbacks, but rather to point to the need for differentiating between one-off patterns. It is folly to make a skeleton pattern even for a large job if many castings are required, but it is equally bad policy to make a first-class solid pattern if only one casting is wanted and there will probably be no further use for it.

Foundry pattern-shops are the worst equipped. They are sometimes located in a corner of the yard or in a shut-off part of a balcony. The position does not matter so much if the light be good, but it seldom is. The machinery—when there is any—usually consists of a lathe and either a circular or a band saw. It must be admitted, however, that a well-equipped shop is not as essential in a foundry as in an engineering works. The foundry patternmaker does 75 per cent., at least, of his work in the moulding shop. In a large jobbing foundry he has to screw cylinder, bedplate, and other patterns together immediately they are withdrawn from the sand so that they are ready for re-moulding; there are many small repairs to be done, but comparatively few new patterns have to be made, consequently a first-class pattern-shop is not really necessary.

The tendency of the present day is to make metal patterns for quantity-production work, but there are limits to their use imposed by weight considerations, and there is also the difficulty of altering metal patterns. Much of the work that is made with metal patterns to-day could as cheaply and satisfactorily be made from wood patterns. This does not imply, however, that metal patterns could wisely be dispensed with. On the contrary, a useful expedient, when several castings are required urgently, is for the first casting made to be used as an additional pattern. For repetition work metal patterns may be better than wood patterns, and there is certainly an advantage in making a metal pattern for some classes of work when the metal is thin and a shell pattern preferred.

The interesting question of whether the head should be a foundryman, a patternmaker, or a draughtsman is sometimes considered as having an important bearing on the patternmaking costs. There does not appear to be as many draughtsmen in charge of pattern-shops as was the case a number of years ago, and the number in charge of foundries is smaller still. Patternmakers holding positions as foundry managers are common; they are usually men who have had a wide experience of foundry patternmaking, and, in some cases, have had practical moulding experience. It really does not matter very much whether the manager is a moulder or a patternmaker as long as he is a competent foundryman, and either moulder or patternmaker can be that.

It has been said that engineers do not always realise the important relation that patternmaking methods have upon foundry production costs, but this is not strictly correct, because the pattern-shop is invariably regarded as the department which loses money; it is non-productive in the sense that it does not produce a finished product like the foundry, the machine shop and the fitting shop. The subject of patternmaking and its relation to foundry costs is a large one which deserves the very careful consideration of all interested in foundry production.

Midland Building and Allied Trades' Exhibition.—The second Midland Building and Allied Trades Exhibition, being held at Birmingham, September 5 to 17, has been organised by the Birmingham Chamber of Commerce (Inc.) in response to representations from the majority of exhibitors at the exhibition the Chamber originated in 1925. The aim has been to show the latest developments, not only in building construction, where there are many new phases to be recorded, but also in the numerous allied trades. The newest method of heating, lighting and ventilation is being shown in operation; the regulation of temperature in the broadest sense, from the production of heat for culinary purposes to the preservation of even atmosphere throughout the home or the factory, is forming one of the most important sections in this exhibition. Structural-steel work, metal partitions and screens and expanded metal for many different purposes, form another notable section. Builders' ironmongery and hardware will present many new features of interest.

XUM

Silica Bricks for Steel Foundries.

In the course of a Paper on "Silica Bricks for Steel Works," by MR. A. H. MIDDLETON and MR. C. BRIDE, read before a meeting of the West of Scotland Iron and Steel Institute and appearing in the "Journal" of the Institute, the authors point out that an ideal refractory should possess high refractoriness, great mechanical strength at all temperatures, resistance to spalling on sudden heating, anti-slagging properties, resistance to abrasion by furnace gases, and minimum thermal expansion. At present, it is probable that these properties cannot be developed simultaneously to their greatest values. A good silica brick represents a useful compromise of these qualities, and some good points may have to be sacrificed for special applications, where superiority in another way is considered to be more important.

Different users, being only human, are bound to hold different opinions on the relative importance of various characteristics. Ultimately, as our skill increases, we hope to be able to manufacture refractories for specific purposes with properties adapted to give the best results for those purposes. Of the properties described in the Paper, the chemical composition within the range considered has the least effect on the behaviour of the refractory in use. It depends on the composition of the raw stone and on the amount of added fluxes. To some extent the composition determines the melting point. An increase in silica content causes an increase in melting point, and the presence of iron, alumina, magnesium, calcium and alkalies causes lowering: their effect being greatest in the case of alkalies and least in the case of iron. Provided that the silica content is above 95 per cent., the effect of varying composition on the melting point is small.

Refractoriness of Silica Refractories.

The observed refractoriness of silica refractories is the temperature at which the material loses its shape. The matrix assumes a fairly fluid state at a lower temperature, but the fragments are more difficult to melt, and, if in sufficient quantity, will form a sort of framework which retards the actual softening, until the melting of the matrix is well advanced. An examination of a fused silica brick will show that the fusion is almost entirely confined to the matrix. The texture of the material, therefore, has an effect on the melting point. A high refractoriness is very desirable, but it must be remembered that, in most cases in steelworks practice, fusion is brought about by a combination of heat and contamination with slags and dusts, which can form low melting compounds, so that other characteristics are necessary besides a high melting point.

Under pressure, the melting point of most silica refractories is lowered by about 50 deg. C. The distortion or collapse in this case is the result of a breakdown of the matrix. When the latter loses its viscosity and powers of adhesion sufficiently to be unable to withstand the applied pressure, collapse occurs. The point of collapse is dependent to a small extent on the pressure applied. However, with the majority of silica refractories on the market, the lowering of the melting point by loads likely to be developed in furnace constructions is not serious. Another function of the matrix is the production of mechanical strength. This property is necessary if the refractory is to withstand transport from maker to user without damage. The cold crushing strength of various types of silica material varies from 1,000 lbs. per sq. in. up to from 4,000 to 5,000 lbs. per sq. in. Well-burnt and converted material has the greatest strength, and this feature can be increased by the addition of fluxes to give a well-converted matrix, but this addition may cause a lowering of the melting point of the refractory. The development of a strong matrix is best accomplished by sufficient heating in the kilns.

Effect of Silica Conversion of Silica.

The degree of silica conversion of silica attained during manufacture has a pronounced effect on the spalling properties of the material when it is heated from cold to working temperatures. The magnitude and rapidity with which the volume changes occur, which are associated with the *alpha-beta* transition changes of the modifications of silica present, determine the internal strains set up in the refractory and the spalling shown. The cristobalite change is the most serious, and as it occurs at the comparatively low temperature of 220 deg. C., much damage can be done before a furnace appears to be really warm. The changes due to quartz and tridymite are comparatively small, and with moderate rates of heating will occur without apparent effect on the material. To some extent internal strains can be accommodated in the matrix. For example, if the matrix is weak mechanically, some movement of its constituents is possible. Such a condition is found in under-burnt, badly-converted material which has received insufficient heating in the kilns to cause vitrification of the matrix or extensive conversion of the quartz. Thus, under-burnt material shows desirable non-spalling properties at low temperatures on account of the weakness of the matrix, and also on the gradual volume change which the quartz shows at its inversion temperature.

Such material has its uses in cases where sudden heating is unavoidable, as in hot patching work. However, at furnace heats the conversion of quartz, which should have been accomplished in the kilns, continues whilst the material is in use. The large permanent growth, due to the formation of the less dense forms of silica, will result in serious crushing of the brickwork unless properly accommodated. As the material receives a one-sided heating in most parts of the steelworks furnaces, such growth persists over lengthy periods and is difficult to manage. In addition, internal strains, such as may cause a form of high-temperature spalling, are possible. Well-burnt material, on the other hand, shows no after-growth, and although its superior conversion results in a more rigid matrix than that found in under-burnt material, it is to be preferred for most purposes.

Some of the volume changes of the free silica may be absorbed by the pore spaces in the material when these are situated next to the expanding grains. This is probably one of the reasons why variations in spalling tendencies exist between various types of silica material equally well converted. A porosity of 28 to 30 per cent. has been suggested as an optimum value, but the size of the individual pores has some bearing on the matter. As the conversion proceeds to its limit in practice the spalling tendencies diminish as the amount of cristobalite decreases and the tridymite development increases. The matrix gains some elasticity owing to the interlocking arrangement of the tridymite crystals, and owing to the volume change of tridymite at its *alpha-beta* inversion, temperature being small and slow enough to cause no weakness in the material. Therefore, if a maximum resistance to spalling is required in well-converted material, it is wise to choose the material which contains the greatest tridymite growth. Seasoned bricks, which have been in use for some time and have a greater tridymite growth than the brick manufacturer can produce economically, show this resistance to spalling in a marked degree.

Corrosion of Brickwork.

The well-converted structure containing plenty of tridymite is also the best for resisting corrosion by molten slags and hot furnace dusts. In such cases the susceptibility of the matrix to corrosion is the main factor in determining the life of the brick.

According to Scott, corrosion by molten slag consists in solution of the refractory material in the slag. Such a solution will proceed to a point of saturation, and then further solution of the refractory can occur only by diffusion of fresh unsaturated slag coming into contact with the refractory. If the saturated solution is more viscous than the slag, and has a higher melting point, diffusion will be retarded, and further corrosion will be difficult. If the saturated corro-

sion has a greater fluidity than the slag corrosion will proceed. Such a description seems to fit in the case of the walls and roof of a furnace. The viscous glaze which forms there often provides a protective coating against further attack. A high concentration of free silica in the matrix appears to be the most serviceable in such cases, and this can be obtained by a suitable blending of raw materials and grinding to give the right texture.

Of the three forms of silica possible in manufacture, quartz, although the low-temperature form, exists in the largest crystalline form and is the most dense, so that it offers less surface to be dissolved. However, at furnace heats this advantage is of doubtful value on account of the conversion of quartz which will occur, thus giving a cristobalite and tridymite brick, and also introducing the question of after-growth. Well-converted material containing a good proportion of tridymite, especially in the matrix, affords the most satisfactory constitution, as this formation shows satisfactory resistance to lag attack. The action of hot dusts results in solutions similar to those of molten slag. The matrix of silica refractories possesses some degree of fluidity at steelworks temperatures, and can very easily enter into combination with dusts when in this condition. This fluidity is demonstrated by the fact that used furnace bricks show a variation in composition, *e.g.*, in the lime content, from hot to cold ends. This migration of constituents indicates a state of fluidity. This type of corrosion is obviously less likely when the area of the exposed matrix is small. Therefore, for roofs and back linings the authors think that a moderately coarse and well-graded texture, with the minimum of matrix consistent with strength, is the best constitution for silica material, provided that the conversion of the quartz is well advanced to cristobalite and tridymite.

Destruction of the port blocks appears to be the result of actual penetration of dust into the silica refractory. The blocks stand directly in the path of the furnace gases, and at furnace temperature the dust is driven into their surfaces. The matrix recedes before the advance of the dust and finally pieces of brick become detached from the main body and fall into the furnace. This penetration proceeds through pores and cracks in the brickwork, and is best resisted by a very dense material. As the porosity of these refractories is determined mainly by the matrix, conditions of manufacture must be arranged to give a minimum porosity. It is not advisable to increase the amount of added bond to produce better vitrefication of the matrix, as this will impair the refractoriness, and an easily melted matrix will be as bad as a highly porous one.

Maximum Tridymite Growth Desirable.

The most resistant structure seems to be that developed by producing a medium-grained texture in the grinding process and by giving material sufficient firing in the kilns to produce the strongest possible tridymite growth in the matrix. By this means the porosity is reduced, and in addition a hard structure is produced which will resist the abrasive action of the furnace gases. Similar bricks should be serviceable in the door jambs where the tridymite structure will show more mechanical strength than less converted material. For chequer bricks, highest refractoriness is, perhaps, not so essential, but a hard dense composition is required to resist the abrasion and penetration of the dusts collecting there.

Finally, greater immunity from corrosion is obtained when the inner surfaces of a furnace are smooth and show no projections which can cause sudden changes in the path of the furnace gases, or on which the dust and slag can lodge. True clean shapes, made accurately to size, are essential to secure these conditions. By their use, the area of the joints exposed can also be reduced to a minimum. A joint is always one of the weak points in a construction working at high temperatures. Although the joint may be similar in chemical composition and refractoriness to the adjacent brickwork, it can never have exactly the same characteristics, as it has not been through all the processes of manufacture necessary to develop these characteristics, and thus forms an easy point of attack for corrodants.

Good shapes in silica refractories are only obtained by employing the best methods of moulding. Accuracy of size depends mainly on the control of the kiln firing, provided that the moulding has been done satisfactorily. Unless the conversion and the growth occurring on firing are taken to their practical limit, variations in size are inevitable in the contents of a kiln. For this reason well-converted material shows much greater uniformity of size than under-burnt material.

A Plumber's Adventure.

By H. LITTLEHALES.

When Mr. John Laicock, a York plumber, returned to his home one evening in September, in the year 1507, he had a fine tale to tell his wife. Mr. Laicock was a plumber in the days of King Henry the Seventh. On the death of Archbishop Savage of York in September, 1507, it was decided according to a practice by no means very uncommon at the time to separate the heart of the Archbishop from the body and to bury the heart and body separately.

It was arranged, following the usual custom in such cases, to enclose the heart in a metal casing, and to Mr. John Laicock fell the duty of enclosing the prelate's heart. Commonly the metal used on these occasions was lead, but in this case pewter was chosen. Mr. Laicock, for his work, was paid the sum of 6s. 8d., a substantial amount in those days.

The method of enclosing the heart is not described in the funeral bill, but from examples found in ancient churches we know well the plan which was commonly adopted, and which was, we may feel sure, carried out in the case of the archbishop. The heart was not put into a box of any kind, but the plumber, taking a sheet of lead, or pewter, would bend it over and round the heart. With the shears the overlapping and redundant metal would be removed and the edges being then brought together would be soldered.

The accounts in connection with the money expended on the archbishop's funeral in York Minster still exist, the payment to Mr. Laicock forming one of the items set down. The bill was made out on September 14, 1507: it has been printed in Volume 53 of the publications of the Surtees Society.

Teaching the London Youth Foundry Work.

We have been favoured with the syllabus of classes to be held during the forthcoming session at the Sir John Cass Technical Institute, Jewry Street, Aldgate, London, E.C., and from it we note that excellent facilities are available for the learning of foundry practice. The principal, Mr. Geo. Patchin, as head of the department of metallurgy takes a close personal interest in the foundry classes, the teaching of which is in the hands of Mr. A. F. Gibbs. The chief recommendation of this school is that many of the studies allied to foundry practice can be taken up, such as metallurgy, mineralogy, fuels, metallography and pyrometry. The only really worth-while branch not specially catered for is refractory materials. We strongly urge London foundry managers and foremen to bring to the notice of the young boys and men coming under their control the advantages to be gained by studying at either the Sir John Cass or one or other of the technical evening classes specially arranged for their benefit. It should be noted that the classes start on September 19.

Proposed Iron and Steel Works in Dalmatia.—Yugoslav vessels have hitherto been repaired in Trieste or Fiume. According to a report from the former port, the Yugoslav Government now intends to establish a shipbuilding yard at Split (Spalato), in Dalmatia, for the building of vessels of up to 14,000 tons, for both the war and merchant navy, and also to erect steelworks to manufacture rails and railway rolling stock.

Brass—a Historical Note.

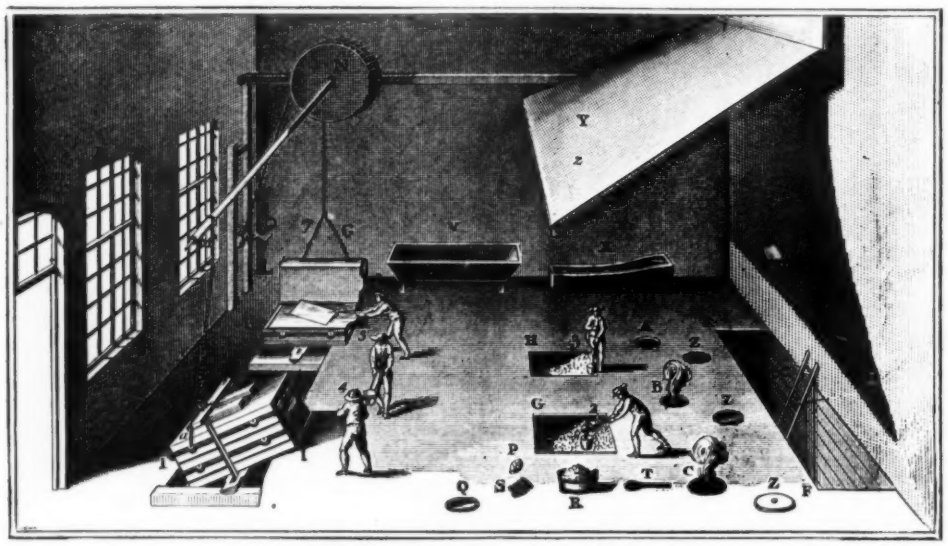
BY OUR METALLURGICAL CORRESPONDENT.

Even to-day some confusion exists in the alloys represented respectively by the terms brass and bronze, and this confusion evidently dates back to very early times. The term brass to-day is more strictly confined to those alloys of which copper and zinc are the predominating constituents. There are certain exceptions in the common alloys of copper and zinc in which the alloys are referred to as bronze. The most common example is manganese bronze, which is a copper-zinc alloy containing small proportions of manganese, etc. For the sake of strict uniformity of nomenclature this alloy should be referred to as brass, and might strictly be referred to as manganese brass. This question has often been referred to by our leading metallurgists, and with the same exceptions the term "bronze" is confined to those alloys of which the essential constituents are copper and tin. The early history of brass as distinct from bronze is very much obscured as a result of this confusion of terms. It appears that both terms have been used indiscriminately to refer to copper-tin and copper-zinc alloys. The use of copper itself and its alloys have been resorted to from the earliest times, and it is very probable that the earlier alloy was the copper-tin alloy—bronze. Copper and bronze articles have been found in Egypt that date from the fourth dynasty, between the years 3800 to 4700 B.C. In Egyptian hieroglyphics or sign writings the crucible is the emblem for copper, a fact which would indicate the use of crucibles for melting and refining this metal. The remains of Mycenean, Phœnician, Babylonian and Assyrian civilisations have all yielded endless copper and bronze objects. In its older use the term brass (old English *braes*) was applied indiscriminately to alloys of both copper and tin and copper and zinc, and more often than not the term brass was used to identify copper zinc alloys which are now definitely described as bronzes. The term brass used in the Bible probably has reference to copper-tin or bronze alloys. In II Chronicles, 4, 1, in the description of King Solomon's temple it is stated that, "Moreover he made an altar of Brass," and in II Chronicles, 4, 16, "Pots, shovels and the fleshhooks and all their instruments did Huram his father make to King Solomon—of bright brass."

The Romans comprehended a brass alloy and differentiated between it and the Latin "aes" commonly translated brass, which really signifies either pure copper or bronze. The title given to the brass alloy of the Romans was "orechalcum," or "aurechalcum," into which Pliny states that copper was converted by the aid of Cadmia. The word bronze now used to signify copper-tin alloys has been etymologically connected with the same root as appears in the word brown, inferring an allusion to the brown colour as distinct from the more yellow colour of brass. According to Berthelot (La Chemie au Moyen Age), the term bronze is derived from the place name, the Aes Brunduseanum of Pliny (c.f. Pliny, Nat. Hist. XXXIII, ch. ix, p. 45). Pliny states that a flourishing trade was carried on in bronze in Rome shortly after the founding of that city, and Numa, the immediate successor of Romulus, formed all the workers engaged in the production of this alloy into a kind of community.

Even as late as the year 1822 the term brass has been confounded with bronze and used to signify copper-tin alloys. The Rev. John Hodgson (Soc. of Antiquaries, Newcastle-on-Tyne, 1822) states that tin is the most common of all the alloys which the ancients used with copper in making brass.

The first unmistakable reference to brass in literature was made by Discorides in the first century, and the first accurate technical description of the preparation of brass does not appear until the thirteenth century, when Theophilus described the calcining of calamine and its mixture with finely divided copper in glowing crucibles. The earliest accounts of brass making all describe the use of calamine, Lapis calamaris and Black Jack in the manufacture of brass. These substances are zinc ores, the calamines are alternatively known as zinc spar and consist of zinc carbonate, and the Black Jack or zinc blende consists of zinc sulphide. Metallic zinc was known in the Far East long before in Europe, and it was imported from the East in considerable quantities as early as the sixteenth and seventeenth centuries. Spianter, from which our name of spelter is supposed to be derived, is one of the names under which the Orientals marketed zinc. It was not until about the beginning of the eighteenth century that metallic zinc became well known and used directly in the preparation of brass. From the records in the British patent journals we find that calamine is used in the preparation of brass until the year 1780, when we have the first mention of the word zinc. In the patent No. 1,243, A.D. 1780, February 5 (Matthew Sanderson), we are told that "Calcined blende being cemented with a phlogistic matter, the *semi*-metallic matter called zinc is obtained, which, being confined by fusion with granulated copper, a beautiful brass resembling gold is obtained." The earliest record of "brasse" in the British patent journals is in the year A.D. 1636, April 22, No. 91, when Sir Phillibert Vernatt was granted a patent for "a sure, safe and readie way for makeinge, melting or smelting, casting, founding . . . of steel, *brasse*, copper, etc." The invention consisted of the use of sea coal, and a royalty of 5s. per ton, or one-tenth part of the inventor's gross profits, were payable to Charles I. The "e" ending to the spelling of



A FRENCH BRASS FOUNDRY IN 1764.

brass was omitted in the year 1728 in the patent No. 495 granted to Francis Hawksbee and others. The patents of Champions' in 1767 and 1779 describe the use of Black Jack (zinc sulphide) in the proportions of four parts granulated copper and six parts Lapis calamaris or Black Jack.

One of the earliest illustrations of brass making plant is to be found in "Untererdische Hofhaltung" (Ecker), page 261, published in 1672. This illustration shows the crucibles and pit furnace for holding eight crucibles. A mixture of 46 lbs. of calamine (zinc carbonate), fine coal, water and salt is divided amongst the eight crucibles, and 8 lbs. of copper added to each. The crucibles were then heated for nine hours and well stirred. After allowing to stand for one hour the molten metal was poured into a mould of Britain stone, so called as a result of its special importation from Britain. Galen, Swedenborg and du Monceau give detailed descriptions of the methods in vogue in the art of brass making in various countries in Europe in Vol. V of the "Proceedings of the Académie Royale des Sciences" printed in 1764. A very interesting print showing the layout of a brass foundry in the county of Namur on the Meuse is given by Galen in this description. Each furnace contains eight crucibles. Pulverised charcoal and calamine are mixed in a small tub and copper added in the form of small balls or shot with the object of obtaining a more intimate mixture. The melted charge is removed from the furnace, skimmed and poured into a larger crucible or ladle large enough to hold the melts from several crucibles. The skimmed contents of the ladle are then poured into the slab moulds or ingot moulds as illustrated. The ingot moulds are hoisted to the horizontal position to enable the slab to be removed. The illustration reproduced in the figure shows very clearly the layout of the foundry. The three pot furnaces, the skimming pits G and H, the ingot moulds, and each operation are clearly illustrated, and the layout of the foundry varies very little from many crucible melting foundries making brass which are in existence to-day.

Automatic Crane Control in Iron Foundries.

By C. H. S. TUPHOLME.

Automatic controllers have inherently many advantages over manually operated controllers for the operation of ladle and hot metal cranes in foundries, and the majority of large iron foundries in this country and abroad are replacing the manually controlled crane by one which is automatically controlled by electricity. One of the most important developments, which has greatly facilitated the introduction of automatic electric control, is the magnetic switch contactor.

Primarily, the contactor is an ideal device for opening and closing a circuit, for the reason that its operation is positive and not under the control of the operator as to the rapidity with which circuit is established or interrupted. Moreover, automatic control systems may be designed to accomplish many results impossible of achievement with manual control systems; and, finally, it should be noted that as contactor type controllers are handled by means of light moving master switches, the element of personal fatigue which enters into the operation of manual controllers of large capacity is entirely eliminated, thereby making for higher daily production, for the simple reason that as the fatigue of the operator increases, his efficiency and, consequently, his output, decreases.

All types of automatic or contactor type control can be divided into two general classes—current limit controllers and time limit controllers.

Current limit controllers are designed to accomplish the acceleration or retardation of the motors with which they are employed in a variable time, maintaining during the period of acceleration or retardation certain predetermined current peaks. This system of control is particularly desirable in connection with motors operating machinery which is stopped and reversed with great frequency under more or less constant load conditions. It is also well suited to work where the running load is less than the starting load. Current limit control is not, as has sometimes been supposed, a system which affords a panacea for all the ills of the controller art, and several installations have resulted unfavourably by the misapplication of this form of control.

Time limit control systems, on the other hand, are designed to start their associated motors in a predetermined time, regardless of the current which may be taken thereby. This form of control is particularly desirable in connection with motors which start under widely varying load conditions, and which should start regardless of the current taken. The time limit is a particularly good type of control to use where automatic overload protection is afforded, for with the time limit acceleration control system and a suitable overload circuit breaking device, the motor will be connected to the line and its current gradually increased to a point where it either starts its load, or is disconnected from the line by the overload device. The time limit control system is well suited for the starting of squirrel cage A.C. motors, whose starting torque is not very high. Such motors should, at the end of a reasonable interval of connection to a reduced potential for starting, be connected directly on the line, where, if not already started, they will either start or trip out their circuit breakers.

The first magnetic switches were provided with auxiliary or arcing contacts of carbon, which preceded the main contacts on closure and lagged behind them on opening, so as to protect the main or current carrying contacts against all arcing. This form of arcing contact was later abandoned in favour of one in which copper and graphite were the co-operating members, the change being made for the purpose of securing arcing contacts having lower resistance than the carbon to carbon contacts. The later form of arcing contact has the advantage of being absolutely non-welding, but it has the disadvantage that if the graphite contact is replaced with one of carbon, the resistance of the arcing contact circuit may be increased to such an extent as to transfer a considerable amount of flashing on to the main contacts.

Spring closed magnetically operated switches are made for use on these controllers where circuits are to be normally closed, as in dynamic brake controllers, having the dynamic circuit in the "off" position of the controller. These switches are provided with contacts that are interchangeable with those used on magnetically closed switches of the same ampere capacity.

Series wound magnetic lock-out switches for acceleration are of the two-coil type, the seeming complication of the second coil being fully justified by the fact that its use permits the attainment of a higher sealing pull and standardises parts to such an extent that the contacts on shunt and series wound switches of any given capacity are interchangeable.

These series wound accelerating switches can be used in combination with shunt wound series relay governed switches in constructing control systems where only a limited number of speed control points are desired, but their greatest field is in the construction of self-starters and in the organising of reversing controllers for motors where single speed control is satisfactory. While they will hold in on a very small percentage of the current required to close them (approximately 10 per cent.), there are certain classes of duty on which they will drop out at light loads. For such duty, they are equipped with shunt-holding coils.

First-Aid Boxes or Cupboards.

The Chief Inspector of Factories announces that by order dated June 27 the Home Secretary has prescribed that, as from October 1, 1927, all materials for dressings contained in the first-aid boxes or cupboards which are required to be provided in pursuance of Section 29 (1) of the Workmen's Compensation Act, 1923, or Regulation 4 (a) of the Docks Regulations, 1925, or Regulation 47 of the Building Regulations, 1926, shall be those designated in, and of a grade or quality not lower than the standards prescribed by, the British Pharmaceutical Codex, 1923.

XUM

Foundry Purchasing—XIII.

By ERIC N. SIMONS.

In placing reception rooms, care should be taken to see that they do not command the buyer's entrance to or exit from his office or department. If they do, he is liable at any moment to be buttonholed by the very people he wishes to avoid. There should always be for him some alternative route. (It might be imagined from this injunction that the policy of evading salesmen is advocated by the writer; but his attitude on this point will be gathered later.)

Reverting to the subject of equipment, another very necessary item for the buying department is a series of partitioned shelves for the storage of past order books. In some offices, movable steel shelving is employed for this purpose, and has the advantage of being clean, portable, adjustable, and dignified. It is, of course, more costly than ordinary deal, and the buyer must decide for himself whether the extra cost is compensated by the undeniable advantages. There is also a tendency to replace the wooden desks and tables by steel furniture. Cabinets for the storage of samples should be glass-fronted and partitioned, with accurate and simple labels to indicate the various classifications. The old card-index cabinets of wood are rapidly being replaced in up-to-date offices by systems of visible records, cards being horizontally filed, with over-lapping edges, in steel trays kept in cabinets of the same metal, or on stands revolving or pivoting about a vertical axis, or even in racks on walls. Typewriters do not vary very greatly in character, but the number of efficient English machines sold at a reasonable price is very much greater than formerly, and it is not now inevitable to purchase an American model. Mention should, however, be made of one important development, which is the introduction of a machine that operates with practically no noise, the everlasting rattle of keys being largely eliminated, with a consequent increase in the quiet (and, it is said, the efficiency) of the office in which they are used. Where there are several machines in use simultaneously, the noise can often be well-nigh deafening, and it is worth while to consider whether the discomfort undoubtedly caused does not justify the expense of ordering the special typewriters, which cost nearly double the price of an ordinary standard make.

Modern office chairs are of the kind that offer firm support for the back, and allow of being swivelled round without the occupant's rising. Except for typewriting, perfectly flat desks are not considered satisfactory, since they have a tendency to make their user round-shouldered and narrow-chested through constant bending over his work. A slight slope is now deemed advisable, with a narrow ledge at the bottom of the slope to prevent pens, etc., from falling off. The roll-top desk is obsolescent, on account of its dust-accumulating powers, and its lack of adaptability to the requirements of the modern office. An invaluable adjunct to the desk is a sorting tray or rack, consisting of a series of rectangular partitions mounted on a piece of wood approximately ten inches wide, the length being decided by the number of partitions required. This stands on the desk, and the occupant sorts into each partition, which is labelled, the letters, papers, etc., for particular destinations. An office-boy or other messenger is then able to collect and deliver these periodically, whether the occupant is at his desk or not, thereby saving much time, and leaving the rest of the desk space clear for use.

One handy means of guarding against forgetfulness is to have a series of coloured cards, measuring, perhaps, three inches by two, each representing a particular day of the year. When an engagement is made, particulars are recorded on the cards for the date concerned, which is then put back in its proper place. Each day, the card for the corresponding date is taken out, scrutinised, and when finished with, filed right at the back of all the other cards. Thus, the cards make their appearance but once a year each. If filled up, they are replaced by clean ones.

Another necessity is a means of keeping well-used telephone numbers at hand to save continual and time-wasting thumbing of directories, etc. For this purpose an ingenious little mechanism can be obtained, consisting of a long strip of paper ruled into horizontal partitions, in each of which is typed, in alphabetical order, the name of a particular firm with its telephone number. This strip is fastened to a roller concealed in a metal case. A window cut in the upper part of this case enables one name and number at a time to be seen. In this way a large aggregate of different telephone numbers can be kept at hand in compact and convenient form. There are, of course, other ways of recording engagements and keeping telephone numbers handy, but these seem to the writer the best and simplest that he has met.

The buying department should also possess a number of useful tools and instruments for various purposes, most of which will be self-explanatory. For example, it should have the following:—Calipers, gauges, a good magnifying glass, a micrometer, a file, a sharp knife, a measuring tape, preferably of steel, a horseshoe magnet. There will be other and specialised instruments and tools needed, according to the kind of foundry concerned, but the above will be essential in almost every buying office. The file, for example, is a good, rough-and-ready means of determining the hardness of metals.

Stationery Stock Room.

This should be located near to or within convenient reach of the buying office itself, so that it can be effectively supervised. The first and most essential requirement is provision against the damage caused by damp and dust. The room should, therefore, be situated in a dry and well-lighted and warmed part of the building. Any infiltrations of dust caused by manufacturing processes should be guarded against by the scrupulously careful partitioning off and sealing up of cracks and crevices. For this reason, it is inadvisable for the stationery stock clerk to occupy the stockroom itself. The necessity to stop up all places through which dust might filter inevitably affects ventilation. It is sufficient if the stock clerk has a key to the room, and allows none but himself to handle or use it. The buyer ought to have a duplicate, so that he may visit and inspect the room at his pleasure. The arrangement of the stock will vary, of course, according to the size of the room, the amount of stock carried, and the character of the stock. In general, heavy packages should be kept where little lifting is needed. Every package should be securely wrapped up, so that dust cannot harm its contents. This applies particularly to notepaper, books, carbon sheets, and so forth. Small objects, *e.g.*, pencils, rubbers, typewriter ribbons, drawing pins, paper fasteners, etc., should be kept in readily accessible cupboards or lockers, so that they can be given out rapidly and without effort, the demand for these being more continuous than for any other class of stationery supplies. Adjustable shelving is sometimes an advantage here also, since it enables re-arrangements of stock to be made without the necessity for heavy and strenuous work. Suppliers should be instructed to affix printed or stencilled labels to each single package they supply, indicating the character and quantity of goods contained in the package. In storing, the clerk should see that these labels are visible. In this way, he will be able to take stock at any given moment with much greater ease than would be possible if he had to open and count the contents of a standard package before being able to estimate how many of a particular commodity he possessed.

THE CLYDE SHIPBUILDING FIRMS during August reported a satisfactory improvement in regard to tonnage, but new orders were more difficult to obtain. During the month 18 vessels, aggregating 37,690 tons, were put into the water. In July the output was 20 vessels of 20,319 tons. In August of last year 14 vessels, measuring 31,993 tons, were launched, and the same month of 1925 had 16 vessels of 55,345 tons to its credit. For the eight months to date the total output is 133 vessels of 203,160 tons, which shows an improvement of some 400 tons over the same period of last year, the figures then being 101 vessels and 202,713 tons. In the comparative eight months of 1925, 169 vessels of 389,233 tons were put into the water.

A Note about Patternmaking Costs.

BY JAMES EDGAR.

The relatively high cost of patternmaking is the serious concern of every engineering firm. A well-known machine tool maker told the writer recently that he had only been enabled to maintain his organisation throughout the depression by manufacturing special machines on which no profits were realised because of the cost of the new patterns which had to be made. It may be admitted at once that patternmaking must always be expensive, except in the case of repetition work, when the same patterns may be used hundreds, or even thousands, of times, the net cost per unit produced being therefore small. In most cases an alteration of design is decided upon before the patterns are worn out. This applies particularly to petrol-engine work, and also in a lesser degree to textile machinery, whilst patternmaking charges for cast gears are not high as a rule, because only a section pattern is made, the work being invariably moulded on a special wheel moulding machine. Machine-tool makers who have a steady demand for their standard machines use the same patterns, with the necessary alterations and repairs, many times, but marine engineers very seldom have a repeat order, and special patterns have to be made each time a contract is secured. It is, in fact, often the case that the prospect of high patternmaking costs acts as a greater deterrent to improvement of design than the subsequent need for new tools and jigs in the metal machine shops. In many engineering works, however, patternmaking costs more than it ought to do.

Possible Economies.

In the case of material it is seldom, if ever, profitable to use inferior timber. Some firms use spruce because of its initial cheapness, but it is very costly in the long run, and this usually applies to one-off jobs as well as to repetition work. There is no gain in using timber that may be, for a given job, £10 cheaper, but will cost £20 or £30 more in labour charges. The resultant castings will also be of poorer quality and probably much heavier than required because of the warping of the timber making it necessary for the moulder to tool his work more than he otherwise would do. Yellow pine is always the most profitable patternmaking timber for all but the smallest work.

The use of metal for patterns has increased during recent years, especially for repetition work. Even when only a few castings are required it is often advisable to make an iron pattern from a flimsy and cheaply made wood pattern. The method is of no use for intricate cored work, but when making coarse castings on which a fine skin is not essential—such as firebars—a rough metal pattern may serve the purpose. This is a very different pattern, however, from the highly-finished pattern for repetition work. Metal patterns are used not so much to reduce pattern-shop costs as to facilitate the founder's work, but it is undeniably true that for a standard casting, whether machine moulded or not, it is often profitable to make a metal pattern. For small work, white metal is often used: a good alloy is composed of tin and zinc, whilst a useful unshrinkable alloy is composed of 85 parts lead, 10 parts antimony, and 5 parts tin. The objection to both these alloys is their comparative softness, which makes them easily dented and distorted; a stiffer and harder alloy, but much more costly, consists of 85 parts tin and 15 parts antimony. Aluminium has become very popular for fine work, such as castings for internal-combustion engines. The first costs may be heavy, but it is well worth the while of firms who specialise in certain directions to investigate the possibilities of metal patterns.

The writer has urged in these columns on previous occasions that without up-to-date machines relatively cheap patternmaking is impossible. In some woodworking shops the machine has quite superseded hand labour, but this cannot happen in the pattern shop. The machines are auxiliary to hand labour, but for economical working they have become very nearly indispensable, and the firm that has a badly equipped pattern-shop in this respect pays heavily in higher production costs. In some cases no changes have been made in the machinery for twenty or more years, and many firms who are thoroughly modern in their other workshops apparently see no need for progress in the pattern shop. For example, antiquated saw benches are still being used, and cylindrical work has to be done by hand because there is not a suitable lathe provided, in spite of the fact that good machines are almost more valuable than expert workmen. Thus, in the case of lathes, wood-turning is not a precision operation, and discarded metal lathes may answer the purpose, although it is more satisfactory to instal new machines. Great improvements have been made in band and circular saw benches in recent years, and machines are now available which reduce bench labour to a minimum.

There are now on the market light machines which require very little power and which should be a real boon to small pattern shops, especially to those engaged on repetition work; bench planers, small saw benches, and portable lathes may be instanced. The trimmer might be thought to be quite indispensable, but some firms still contrive to get along without one, and the same applies to sand-papering machines. The most useful types of sanders for patternmaking are the disc and drum machines, and it is not an exaggeration to say that their use alone reduces patternmaking costs by at least 25 per cent. At one time it was thought that all general woodworking machines were satisfactory for patternmaking, but it is now recognised that special features have to be incorporated in their design, and also that lighter machines serve the purpose much better.

When the wood-milling machine, popularly called the "patternmaking machine," was first introduced, it was anticipated that all firms would ultimately instal them. They have not done so, presumably because of the first cost. These machines—there are several firms making them—eliminate a large proportion of hand labour. Work that would otherwise be turned can be milled in much less time, and almost every kind of cutting operation can be performed with them. It is quite wrong to suppose that they are only suitable for rough and heavy work; they are as valuable for the motor-engine shop as for the repair shop and, like the lathe and the sanders, are finishing machines, no subsequent bench work being necessary.

There is not universal agreement as to the best method of driving pattern-shop machines. All things considered, opinion most often favours the individual electric drive. It is very seldom that all the machines are in use at the same time; indeed, in a shop where there are a dozen machines for the greater part of the day not more than three or four may be running. Consequently, with a line shaft there is a big loss of power, with the further objection that a defective belt will stop all the machines. One sometimes hears it stated that the individual drive is too positive for wood-working machines, but it must be admitted that quite good results are obtained, and it is probably the most economical method of driving under the conditions. The proportion of machine work to bench work also varies in different shops, another factor to be borne in mind.

There will eventually, no doubt, be co-operative pattern shops, and it is surprising that small firms do not join in fitting up a joint pattern shop. Many master pattern shops have sprung into existence in recent years, and they have justified their existence by quoting, in many cases, lower prices than engineering firms could themselves do their work, the reason being that they are excellently equipped for economical production. In nearly all pattern shops there ought to be at least two different grades of patterns; discrimination is not always used. It is wasteful, for example, to make a standard pattern for a repair job, but nearly always good business to finish work well when a quantity of castings is required. Again, cast gears are preferred by many engineers, and even if only one wheel is wanted, and the pattern has afterwards to be scrapped, good patterns are necessary to obtain smooth running gears.

XUM

Random Shots.

"*Tout passe, tout lasse, tout casse,*" say our very good friends the French—or as we might put it ourselves, all good things come to an end—even a Foundry Congress. For four days founders from the four quarters of the globe disported themselves amid the treasures and pleasures of the "*ville lumière,*" and then——back again to reality.

* * *

And now we are back home again, what are the impressions that remain? We were told that some came to work and some to play: well, we all know what a hard worker the founder is when on his native heath, and frivolity on so well-earned a holiday is in its right place. The French are said to excel in cooking, in diplomacy, and in war: for diplomacy let us substitute the art of entertaining, for war the art of founding, and you have an excellent summary of the "Congrès International de Fonderie de 1927."

* * *

As to the exhibition, one could not fail to be struck by the contrast offered to our own recent Foundry Exhibition. In this case the exhibits were not confined to manufacturers of foundry equipment but were furnished largely by the founders themselves, with a considerable degree of business perspicacity. A further very striking feature was the inclusion of several exhibits of very fine artistic founding in bronze and other media—an art which is certainly practised at home but of which little enough is heard or seen.

* * *

For the moment, enough. The charms of Paris are still about us, and only a strong sense of duty to his readers could have torn "Marksman" away from those charms for any reason whatever.

* * *

We are promised one last effort to solve the London traffic problem—the Post Office (London) Railway (this is its full official title) is shortly to be opened, and since by its means a considerable part of London's mails will be carried underground by automatic means the result will probably be the disappearance of about a quarter of the familiar red mail vans. While this appeals to us as being more helpful than the conversion of Piccadilly into a front-line trench or wholesale collapse of buildings, old and new, would it not be still more sensible to do away with the mail vans altogether? It would be quite easy to make it illegal to send anything to London by post—and there would be a great many people who would not be sorry, I am sure!

* * *

The vicar was asked to pray for Mary Lee. . . . He did so with his usual fervour, and a day or two later he met the village reprobate, who had made the request.

"Do you want the prayers repeated Tom, or is Mary Lee better?" he asked.

"Thank 'ee kindly, sir, but ye needn't repeat 'em," Tom said, "She won come Monday at seven to one, sir."

* * *

Herewith some unwritten letters from the postbags of our founder friends:—

"We have pleasure in advising you that the cost of production of the castings being made to your esteemed order is less than we anticipated. We therefore propose to reduce our price by 1s. 6d. per cwt. on that already quoted to you."

* * *

"We fully sympathise with your inability to deliver the core-oil to our recent order. It is true that your failure to do so compelled us to close our works for two days, but under the circumstances we feel satisfied that your efforts were highly creditable."

* * *

"We regret to inform you that our delivery of moulding-sand to your order has been unavoidably delayed by the circumstance that a large proportion of our labourers recently lost their mothers-in-law with tragic suddenness, this causing considerable embarrassment as the bereavement coincided with the dislocation resulting from the local race-meeting."

Trade Talk.

THE EGYPTIAN STATE RAILWAYS have placed an order for 23,900 tons of rails at round £8 a ton, f.o.b. Cardiff, with Guest, Keen & Nettlefolds, Limited.

THE HODBARROW MINING COMPANY, LIMITED, have placed a contract for the sinking of a new shaft at Moorbank, Millom, with the Foraky Boring and Sinking Company, of Doncaster.

HEAD, WRIGHTSON & COMPANY, LIMITED, of Thornaby, have denied the statement to the effect that they have purchased the Stockton Steel Foundry, but apparently negotiations for the deal are in progress.

CONSIDERABLE DAMAGE was caused by fire recently at the pattern store and foundry of P. & C. Garnett, Limited, Wharfe Works, Cleckheaton. The works had been closed down for the annual holidays, and consequently the cause of the fire is unknown.

THE GRANGESBERG COMPANY report for August iron-ore shipments totalling 1,151,000 tons (a record), compared with 1,110,000 tons last July and 653,000 tons in August, 1926. The shipments for the first eight months of the current year aggregate 6,785,000 tons, as compared with 4,105,000 during the corresponding period in 1926.

PETTERS, LIMITED, the Yeovil engineers, will be represented in Scotland by Engineer-Lieut.-Commander J. K. Gibbon, R.N., Waterloo Chambers, 19, Waterloo Street, Glasgow, C.2. The arrangement under which Major R. McPhail has acted as their representative terminated last week. He will also represent Petters (Ipswich), Limited.

FOR SOME YEARS the Margam Works of Baldwins, Limited, have not been wholly utilised. Developments in the iron and steel trade in the Colonies have caused a demand for plant, and it is reported that Baldwins have received an offer for a considerable portion of the mills and equipment at the Margam Works from a large enterprise in New Zealand. The advantage to the purchasers is that they can get delivery at a much earlier date than by ordering new plant.

AN ARRANGEMENT has been come to by which the English interests of the Blaw-Knox Company, of Pittsburgh, U.S.A., have been purchased by Milliken Brothers and Blaw-Knox, Limited, of 12, Norfolk Street, Strand, W.C.2. The steelworks and engineering portion of the business of Christmas and Walters, Limited, hitherto sole concessionaires for Great Britain for the Blaw-Knox Company, however, is being continued as heretofore by Christmas and Walters, Limited.

JAMES GORDON & COMPANY, LIMITED, Windsor House, Kingsway, London, W.C.2, have taken over the complete patent rights for the British Empire, except Canada, and also for all other European countries and their colonies, of the Hagan patent automatic regulation for combustion boiler houses, etc., the Hall patent system of boiler water conditioning, and the Hagan patent steam separator. The new Hagan department is under the management of Mr. J. E. O'Breen, who has had a wide experience with different apparatus during the time he was with the Hagan Corporation, of Pittsburgh, Pa.

THE STEEL UNION TRADING COMPANY (GREAT BRITAIN), LIMITED, Bilbao House, 36-8, New Broad Street, London, E.C.2, had been formed for the purpose of conducting conjointly the businesses of Schurr & Company and R. H. Ferguson, Limited, as from September 1. Mr. Otto Schurr, of Schurr & Company, and Mr. Richard H. Ferguson, of R. H. Ferguson, Limited, will act as managing directors of the company, who are the chief representatives of the Vereinigte Stahlwerke A.G. (comprising Thyssen, Rhine-Elbe Union, Phœnix, Rheinstahl Works, etc.) and of its main sales organisation, viz.: The Stahlunion-Export G.M.B.H. Dusseldorf.

ON JANUARY 29 of this year Mr. R. P. Todd, managing director of the International Aluminium Company, whose works are at Glomfjord, Norway, placed an order with the Metropolitan-Vickers Electrical Company, Limited, for three motor generator sets, each consisting of one 8,000-h.p. 3-phase, 50 period, 6,600-volt motor direct coupled to two 2,760 kw. D.C. generators operating at 370 r.p.m. and arranged for operation at 325/25 volts. The order also comprised the necessary control and starting gear and a small auxiliary motor generator set for separate excitation on the lower voltage range. The order was obtained in the face of severe foreign competition on a promise of delivery, which was five weeks shorter than that made by any of the firms quoting, including German, Swiss and Swedish manufacturers. The actual time taken in executing the order was 27 weeks; the first set being shipped in 23 weeks, the second in 25, and the last two weeks later. This represented an improvement of one week on the guaranteed and promised delivery, a performance which the International Aluminium Company much appreciated.

40 Years' Experience in the Design & Construction of Fans

for

Heating and Ventilation of Buildings, Mines and Ships,
High Pressure Blast for Forges, Furnaces and Cupolas,
Mechanical Boiler Draught,
Fume and Steam Removal,
Dust Removal and Collection,
Cooling and Drying Plants

means

Expert Knowledge, High Efficiency, Reliability & Good Service

Davidson's the TRADE SIROCCO MARK Fan Makers

have an experience covering hundreds of different industries and hundreds of different uses, and they can furnish a Sirocco Fan for every purpose for which a fan can be employed.

Solve your fan problems by using the Sirocco Service.

DAVIDSON & Co. LIMITED

SIROCCO ENGINEERING WORKS - BELFAST

LONDON - BIRMINGHAM - CARDIFF - BRISTOL MANCHESTER - GLASGOW - NEWCASTLE

PIG IRON and High Grade CYLINDER IRON

For Motor Castings.

FOUNDRY & FURNACE COKE

J. C. ABBOTT & Co LTD

LLOYD'S BANK CHAMBERS, NEW STREET, BIRMINGHAM.
TELEPHONE: MIDLAND 170.

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—The improvement noted in last week's report on the conditions prevailing in the Cleveland iron industry has since been fully maintained, and the results of the policy of price-reduction adopted by the ironmasters have satisfactorily justified that decision. This movement on the part of makers has already brought in a few export orders, and a substantial volume of Scottish business, with the net result that on the week makers' stocks of iron, which had been steadily accumulating, have been reduced to the extent of several thousand tons. The outlook for the near future is also distinctly brighter, the usual volume of autumn buying having been largely stimulated, consumers taking advantage of the more favourable prices to purchase more substantial quantities for stocks than has hitherto been practicable. Prices to home consumers—which are subject to a discount of 2s. 6d. per ton on all Scottish and foreign orders—are as follow:—No. 1 Cleveland foundry iron, 70s. per ton; No. 3 Cleveland G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; No. 4 forge, 66s. per ton.

A corresponding revival of interest to that above relating to foundry pig may also be observed in the Tees-side hematite market, in which the home demand is on an expanding scale, and stocks in makers' yards are steadily diminishing, with quotations firmly held at 75s. per ton for East Coast mixed numbers and 75s. 6d. for No. 1 quality. On the West Coast Bessemer mixed numbers are quoted 75s. per ton at furnace.

Metals.

Copper.—Following a reactionary movement, influenced by mid-week adverse advices from New York, the market for warrant copper rallied towards the close, with a firmer tendency in the cash position. This improvement was largely influenced by the issue of the half-yearly statistics showing the apparent consumption for the period as 70,293 tons, which compares with 62,999 for the six months ended December last, and 59,123 for the half-year ended June, 1926.

Official closing prices of standard copper have been as follow :—

Cash : Thursday, £54 10s. to £54 11s. 3d.; Friday, £54 7s. 6d. to £54 8s. 9d.; Monday, £54 6s. 3d. to £54 7s. 6d.; Tuesday, £54 6s. 3d. to £54 7s. 6d., Wednesday, £54 16s. 3d. to £54 17s. 6d.

Three Months : Thursday, £55 to £55 1s. 3d.; Friday, £54 17s. 6d. to £54 18s. 9d.; Monday, £54 17s. 6d. to £54 18s. 9d.; Tuesday, £54 17s. 6d. to £54 18s. 9d; Wednesday, £55 6s. 3d. to £55 7s. 6d.

Tin.—In this section of the market also interest was chiefly centred in the publication of the tin statistics for August. According to various estimates, the total visible supply has been reduced by some 600 tons. Metal brokers had looked for a larger reduction, and some had estimated for a drop in stocks of as much as 1,000 tons. The present holding is approximately 13,725 tons. An interesting point in the situation at present is the belief that the available amounts in the Straits during the current month will be about 10,000 tons.

Official closing prices of standard tin have been as under :—

Cash : Thursday, £289 to £289 5s.; Friday, £289 10s. to £289 15s.; Monday, £287 17s. 6d. to £288 2s. 6d.; Tuesday, £284 to £284 5s.; Wednesday, £284 15s. to £285.

Three Months : Thursday, £284 5s. to £284 10s., Friday, £283 15s. to £284; Monday, £281 to £281 5s.; Tuesday, £278 10s. to £278 15s.; Wednesday, £279 5s. to £279 10s.

Spelter.—Values of ordinary spelter during the past week have disclosed an irregular tendency, consequent upon a slow demand and easier American advices. According to one merchant, the comparative easiness of September latterly has been due to arrivals of metal surplus to requirements, which, therefore, have been liquidated.

The following are the week's prices :—

Ordinary : Thursday, £27 8s. 9d.; Friday, £27 5s., Monday, £27 1s. 3d.; Tuesday, £27 5s.; Wednesday, £27 10s.

Lead.—The market for soft foreign pig, for some time the weakest section in base metals, continues flat and irregular, with a distinct lack of confidence, prices now quoting some £10 lower than the current figures for the corresponding period in 1926. No immediate improvement can be expected, the continued large arrivals on this side having accumulated stocks to an unwieldy extent.

The week's prices are appended :—

Soft foreign (prompt) : Thursday, £21 18s. 9d.; Friday, £21 8s. 9d.; Monday, £21; Tuesday, £21 3s. 9d.; Wednesday, £21 6s. 3d.

Company Reports.

Mansfield Engineering Company, Limited.—Loss, £2,685.

Brown Brothers & Company, Limited.—Interim dividend, 6d. per share, less tax, on ordinary.

Clarke, Chapman & Company, Limited.—Interim dividend, 2 per cent., less tax, on ordinary shares.

Fisher & Ludlow, Limited.—Interim dividend, 7½ per cent. (actual), less tax, on ordinary 10s. shares for year.

R. & W. Hawthorn Leslie & Company, Limited.—Dividend, 2½ per cent. (6d. per share) on ordinary shares.

Davis & Timmins, Limited.—Interim dividend on ordinary shares, 6 per cent. per annum, free of tax, for half-year.

Wallsend Slipway & Engineering Company, Limited.—Interim dividend, 2½ per cent., free of tax, on ordinary shares.

Elliott's Metal Company, Limited.—Net profit, £57,162; dividend, 10 per cent. on ordinary shares; carried forward, £55,869.

Ashton Vale Iron Company, Limited.—Profits, £6,532; brought forward, £3,143; dividend, 5 per cent.; carry forward, £3,929.

Dalmellington Iron Company, Limited.—Final dividend, 1s. 6d. per share on ordinary shares, making 10 per cent. for year, free of tax.

William Bayliss, Limited.—Net profit, £2,311; brought in, £7,060; total, £9,372; interim dividend, 3 per cent., £1,800; final dividend, 4 per cent., free of tax, £2,400; carry forward, £5,172.

William Roberts (Tipton), Limited.—Profit, £1,704; brought forward, £4,136; one year's dividend on cumulative preference shares to March 31, 1925 (less tax), £1,680; carried forward, £2,456.

Brightside Foundry and Engineering Company, Limited.—Profit, £5,566; amount brought forward, £4,700; total, £10,266; interim dividend for first half of year on £45,000 5 per cent. preference shares, £1,125; balance, £9,141; half-year's preference dividend to June 30, 1927, £1,125; dividend, 4 per cent., less tax, on ordinary shares, £3,200; carry forward, £4,816.

Personal.

MR. E. GURNEY BUXTON has been elected a director of Callender's Cable and Construction Company, Limited.

FOLLOWING UPON THE resignation of Sir Vincent Caillard from the board of Vickers, Limited, Sir Mark Webster Jenkinson has been appointed financial controller of the company.

MR. JAMES A. FARRELL, president of the United States Steel Corporation, is functioning as the chief executive officer of the Corporation, pending the selection of a successor to Judge E. H. Gary.

Wills.

PLATT, J., of 74, Whitehall Court, S.W., a director of Mather & Platt, Limited £119,916

TURNBULL, T. E., of Cromer Villa, Carslogie Road, Cupar, Fife, ironfounder £1,402

DILWORTH, A., of Lyndhurst, Kilner Park, Ulverston, Lancs., retired iron merchant £10,469

McINTYRE, H., Mossley Hill, Liverpool, principal of McIntyre & Sons, Limited, constructional engineers, North John Street £34,363

Gazette.

THE HORNSEY IRON COMPANY, LIMITED, are being wound up voluntarily. Mr. T. E. Haslam, Sheepbridge Works, Chesterfield, has been appointed liquidator.

MESSRS. A. J. HAYNES & H. W. FLEESON, electrical and mechanical engineers, trading under the style of Haynes & Fleeson, have dissolved partnership. Mr. A. J. Haynes will continue the business.

THE SHAREHOLDERS of the Standard Reinforced Concrete Engineering Company, Limited, have decided to wind up the company voluntarily. Mr. Norman Williamson, 8, Exchange Buildings, Bradford, has been appointed liquidator.

MESSRS. N. S. CROWLEY AND A. S. CROWLEY, stampers and piercers, etc., 82 and 83, Cliveland Street, Birmingham, trading under the style of W. Crowley & Son, have dissolved partnership. Mr. N. S. Crowley will continue the business under the same style.

THE PARTNERSHIP heretofore subsisting between Messrs. T. Robertson and J. Roberts, iron and brass founders, Sykes Street, Reddish, near Stockport, trading under the style of the Reddish Iron & Brass Foundry, has been dissolved. Mr. T. Robertson will continue the business.

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863

JAS. DURRANS & SONS, LTD.

PHOENIX WORKS, PENISTONE, near SHEFFIELD.

Telephone :
21 PENISTONE.

Telegrams :
" DURRANS, PENISTONE."

Manufacturers of

FOUNDRY EQUIPMENTS

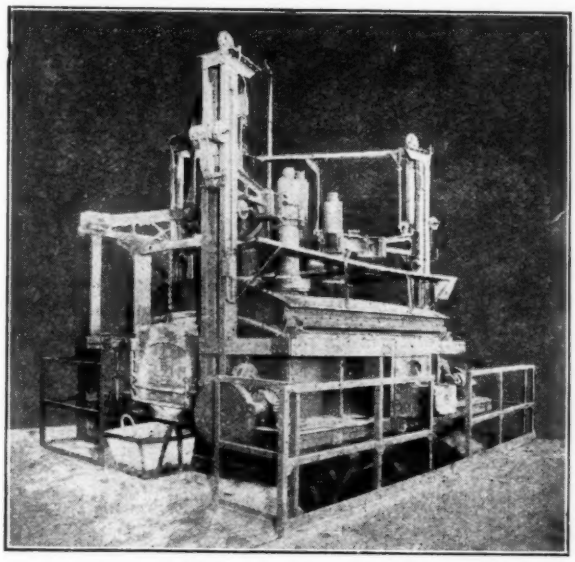
LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

GREAVES-ETCHELLS ELECTRIC STEEL FURNACES

MORE THAN 100 FURNACES SUPPLIED DURING LAST 7 YEARS.

WATSON ROTATING ELECTRIC FURNACES Ensure RAPID & CLEAN MELTING — THOROUGH MIXING.



NON-FERROUS METAL MELTING ELECTRIC FURNACES — SINGLE, TWO, or THREE PHASE.

CONTRACTORS TO HOME AND FOREIGN GOVERNMENTS.

WATSONS (METALLURGISTS) LIMITED

Lancaster Street, SHEFFIELD

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	54	16	2
Three months	55	6	3
Electrolytic	61	15	0
Tough	59	0	0
Best selected	59	15	0
Sheets	86	0	0
India	72	0	0
Wire bars	62	5	0
Do. September	61	5	0
Do. October	61	5	0
Ingot bars	62	5	0
H.C. wire rods	66	15	0
Off. av. cash, July	54	11	8 5/16
Do. 3 mths. July	54	19	9½
Do., Sttlmnt. July	54	11	6½
Do., Electro, July	60	6	6½
Do., B.S., July	58	15	3½
Aver. spot price copper, July	54	11	8½
Do., wire bars, July	60	11	3½

Solid drawn tubes 12½d.
Brazed tubes 12½d.
Wire 9½d.

BRASS.

Solid drawn tubes 11½d.
Brazed tubes 13½d.
Rods, drawn 10½d.
Rods, extd. or rlld. 7½d.
Sheets to 10 w.g. 9½d.
Wire 9½d.
Rolled metal 9½d.
Yellow metal rods 7½d.
Do. 4 × 4 Squares 8d.
Do. 4 × 3 Sheets 8½d.

TIN.

	£	s.	d.
Standard cash	284	15	0
Three months	279	5	0
English	282	15	0
Bars	284	0	0
Straits	289	10	0
Australian	289	0	0
Eastern	283	5	0
Banca	295	0	0
Off.avr.cash, July	288	16	3
Do., 3 mths., July	281	19	3 7/8
Do., Sttlmt. July	288	15	11 7/8
Aver. spot, July	288	16	3

SPELTER.

	£	s.	d.
Ordinary	27	10	0
Remelted	25	15	0
Hard	21	10	0
Electro 99.9	30	12	6
English	27	15	0
India	23	15	0
Zinc dust	36	0	0
Zinc ashes	9	5	0
Off. aver., July	28	3	0 1/16
Aver., spot, July	28	5	7

LEAD.

	£	s.	d.
Soft foreign ppt.	21	6	3
English	23	0	0
Off. average, July	23	14	2 7/8
Average spot, July	23	9	9¾

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	36	0	0
Do. V.M. ex whf.	34	10	0
Rods	42	0	0
Boiler plates	34	0	0
Battery plates	33	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	65	0	0
Chinese	46	10	0
Crude	38	0	0

QUICKSILVER.

Quicksilver £21 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—
25% £8 15 0
45/50% £12 15 0
75% £19 17 6
Ferro-vanadium—
35/40% 14/3 lb. va.
Ferro-molybdenum—
70/75% c. free 5/- lb.
Ferro-titanium—
23/25% carbonless 11½d.
Ferro-phosphorus, 20/25%, £17 15 0
Ferro-tungsten—
80/85%, c. fr. 1/3½ lb.
Tungsten metal powder—
98/99% 1/8 lb.
Ferro-chrome
2/4% car. £33 15 0
4/6% car. £23 15 0
6/8% car. £22 15 0
8/10% car. £22 7 6
Ferro-chrome—
Max. 2% car. £36 0 0
Max. 1% car. £42 5 0
Max.0.70% car. £54 0 0
70%, carbonless 1/4½ lb.
Nickel—99%, cubes or pellets £170
Ferro-cobalt 9/3 lb.
Aluminium 98/99% £105
Metallic chromium—
96/98% 3/- lb.
Ferro-manganese (net)—
76/80%, loose £12 0 0
76/80%, packed £13 0 0
76/80%, export £11 15 0
Metallic manganese—
94/96%, carbonless 1/10 lb.
Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten s. d. 2 6
Finished bars, 18% tungsten 3 0
Per lb. net, d/d buyers' works.
Extras—
Rounds and squares 3 in. and over 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to ⅜ in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅜ in. 3d. lb.
Do. under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra.
Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.
Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.
Hvy. steel	2 17 6 to 3	0	0
Bundled steel & shrngs	2 10 0 to 2	12	6
Mixed iron & steel	2	12	6
Heavy cast iron	2 17 6 to 3	0	0
Good machinery for foundries	3 0 0 to 3	2	6

Cleveland—			
Heavy steel	2	15	0
Steel turnings	2	4	6
Cast iron borings	2	2	6
Heavy forge	3	12	6
Bushelled scrap	3	3	0
Cast-iron scrap	3 1 0 to 3	5	0

Lancashire—			
Cast-iron scrap	3	5	0
Hvy. wrought	3	2	6
Steel turnings	2	2	6

London — Merchants' buying prices delivered yard.

Copper (clean)	48	0	0
Brass (clean)	38	0	0
Lead (less usual draft)	19	10	0
Tea lead	17	0	0
Zinc	17	0	0
New aluminium cuttings	80	0	0
Braziery copper	45	0	0
Gunmetal	48	0	0
Hollow pewter	170	0	0
Shaped black pewter	130	0	0

PIG-IRON

(f.o.t. unless otherwise stated).

N.E. Coast—
Foundry No. 1 70/-
Foundry No. 3 67/6
Foundry No. 4 66/6
Forge No. 4 66/-
Hematite No. 1 75/6
Hematite M/Nos. 75/-
N.W. Coast—
Hem. M/Nos. d/d Glas. 83/6
,, d/d Birm. 92/6
Midlands—
Staffs. common* —
,, No. 4 forge —
,, No. 3 fdry. 65/-
Shrops. basic —
,, Cold blast, ord.* —
,, ,, roll iron* —
* d/d Birmingham.
Northants forge 55/-
,, fdry. No. 3 60/- to 61/-
Derbyshire forge —
,, fdry. No. 3 65/-
,, basic —
Scotland—
Foundry No. 1 —
,, No. 3 74/-
Hem. M/Nos. 76/6
Sheffield (d/d district)—
Derby forge 68/6
,, fdry. No. 3 70/6
Lincs. forge —
,, fdry. No. 3 69/-
E.C. hematite 85/-
W.C. hematite 90/6
Lincs. (at furnaces)—
Forge No. 4
Foundry No. 3 —
Basic —
Lancashire (d/d eq. Man.)—
Derby forge —
,, fdry. No. 3 73/6
Northants foundry No. 3 —
Dalzell, No. 3 105/- to 107/6
Summerlee, No. 3 92/6 to 100/-
Glengarnock, No. 3 92/6 to 100/-
Gartsherrie, No. 3 92/6 to 100/-
Monkland, No. 3 92/6 to 100/-
Coltness, No. 3 92/6 to 100/-
Shotts, No. 3 92/6 to 100/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.	9	15	0 to 10	15	0	
Angles				—		
Tees to 3 united ins.				—		
Nut and bolt iron				—		
Hoops				14	10	0
Marked bars (Staffs.) f.o.t.				13	10	0
Gas strip				12	10	0
Bolts and nuts ¾ in. × 4 in.				15	5	0

Steel—			
Ship plates	8	2	6
Boiler plts.	11	0	0
Chequer plts.	10	5	0
Angles	7	12	6
Tees	8	12	6
Joists	7	12	6
Rounds and squares 3 in. to 5½ ins.	7	15	0
Rounds under 3 in. to ⅜ in. (Untested)	8	0	0
and upwards			
Flats, over 5 in. wide and up	9	2	6
Flats, 5in. to 1½in.	8	2	6
Rails, heavy	8	2	6
Fishplates	12	10	0
Hoops (Staffs.)	10	10	0
Black sheets, 24g.	10	7	6
Galv. cor. shts, 24g.	14	0	0
Galv. fencing wire 8g. plain	12	10	0
Billets, soft	6 0 0 to 7	0	0
Billets, hard	8	2	6
Sheet bars	5 12 6 to 5	15	0
Tin bars d/d	5 12 6 to 5	15	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	2¼
Sheet to 10 w.g.	1	2¾
Wire	1	3½
Rods	1	2¼
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

per lb.
Ingots for raising 9d. to 1/3
Rolled—
To 9 in. wide 1/3 to 1/9
To 12 in. wide 1/3½ to 1/9½
To 15 in. wide 1/3½ to 1/9½
To 18 in. wide 1/4 to 1/10
To 21 in. wide 1/4½ to 1/10½
To 25 in. wide 1/5 to 1/11
Ingots for spoons and forks 9d. to 1/5½
Ingots rolled to spoon size 1/- to 1/8½
Wire round—
3/0 to 10 G. 1/6½ to 2/1½
with extras according to gauge.

AMERICAN IRON & STEEL

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	20.76
No. 2 foundry, Valley	17.50
No. 2 foundry, Birm.	17.25
Basic	20.00
Bessemer	19.96
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80% d/d	90.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	43.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.80
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.80
Skelp, sheared steel	1.80
Steel hoops	2.30
Sheets, black, No. 24	3.00
Sheets, galv., No. 24	3.85
Sheets, blue an'l'd, 9 & 10	2.25
Wire nails	2.55
Plain wire	2.40
Barbed wire, galv.	3.25
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry —
,, furnace —
Durham & North.
,, foundry —
,, furnace 14/- to 15/-
Other Districts, foundry —
,, ,, furnace (basis) 12/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	18/4½
,,	28×20, ,,	36/9
,,	20×10, ,,	—
,,	18¾×14, ,,	—
C.W.	20×14, ,,	17/4½
,,	28×20, ,,	—
,,	20×10, ,,	—
,,	18¾×14, ,,	—

Terneplates 28 × 20, — per box basis f.o.b.

SWEDISH IRON.

Bars, hammered £18/10 to £19/0
Rolled Ord. £15/0/0 to £15/10
Nail rods £15 7 6 to £15 15 0
Keg. steel nom. £33 to £35
Faggot steel nom. £22 to £25
Blooms, according to quality £8 to £12
Pig-iron £5 15 0 to £6 0 0 all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	Fittings
Gas ..	67½% ..	45%
Water ..	63¾% ..	40%
Steam ..	60% ..	35%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Sept. 8	54	10	0	dec. 3/9
,, 9	54	7	6	,, 2/6
,, 12	54	6	3	,, 1/3
,, 13	54	6	3	No change
,, 14	54	16	3	inc. 10/-

Electrolytic Copper.

	£	s.	d.	
Sept. 8	62	0	0	No change
,, 9	61	15	0	dec. 5/-
,, 12	61	15	0	No change
,, 13	61	15	0	,, ,,
,, 14	61	15	0	,, ,,

Standard Tin (Cash).

	£	s.	d.	
Sept. 8	289	0	0	dec. 30/-
,, 9	289	10	0	inc. 10/-
,, 12	287	17	6	dec. 32/6
,, 13	284	0	0	,, 77/6
,, 14	284	15	0	inc. 15/-

Tin (English ingots).

	£	s.	d.	
Sept. 8	287	0	0	dec. 20/-
,, 9	287	10	0	inc. 10/-
,, 12	286	0	0	dec. 30/-
,, 13	282	0	0	,, 80/-
,, 14	282	15	0	inc. 15/-

Zinc Sheets (English).

	£	s.	d.	
Sept. 8	36	0	0	No change
,, 9	36	0	0	,, ,,
,, 12	36	0	0	,, ,,
,, 13	36	0	0	,, ,,
,, 14	36	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Sept. 8	27	8	9	dec. 2/6
,, 9	27	5	0	,, 3/9
,, 12	27	1	3	,, 3/9
,, 13	27	5	0	inc. 3/9
,, 14	27	10	0	,, 5/-

Lead (English).

	£	s.	d.	
Sept. 8	23	5	0	dec. 5/-
,, 9	22	15	0	,, 10/-
,, 12	22	15	0	No change
,, 13	22	15	0	,, ,,
,, 14	23	0	0	inc. 5/-

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
1895	2 3 0	2 3 0	2 2 6	2 2 6	2 2 6	2 4 0	2 3 6	2 4 0	2 5 0	2 5 6	2 6 6	2 5 6	2 3 11½
1896	2 5 6	2 6 0	2 6 0	2 6 0	2 6 0	2 5 6	2 5 0	2 5 0	2 5 0	2 6 0	2 7 0	2 8 6	2 5 11½
1897	2 10 0	2 11 0	2 9 0	2 8 6	2 8 0	2 7 0	2 7 0	2 7 0	2 6 0	2 6 0	2 6 6	2 7 6	2 7 9½
1898	2 7 6	2 8 0	2 8 0	2 8 0	2 8 6	2 10 0	2 10 0	2 10 0	2 10 0	2 11 0	2 14 0	2 14 0	2 9 11
1899	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 0	3 6 2½
1900	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6.	2 17 6	2 17 6	2 17 1¼
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12 6	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0¼
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 15 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2½
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	12 12 1½	
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 16 10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	4 10 0	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	3 13 4½	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	—	—	—	—	—

* No prices available during strike period.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

18, BENNETTS HILL, BIRMINGHAM.
11, OLD HALL STREET, LIVERPOOL.
ROYAL BLDS., FISHER ST., SWANSEA.
FOWLERS BUILDINGS, BOMBAY.
CLIVE STREET, CALCUTTA.
20, SECOND LINE BEACH, MADRAS.
1, HONG KONG ROAD, SHANGHAI.

REGISTERED TRADE MARK

OCEAN BUILDING, SINGAPORE.
JAVA STREET, KUALA LUMPUR.
5, SHAFFRAZ ROAD, RANGOON
NADIR HOUSE, MACLEOD ROAD, KARACHI.
1 SHAREH SONK EL TEWFIKIEH, CAIRO.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 7 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

ADVERTISER, twenty years' practical Foundry experience, five years' commercial travelling, seeks change, as Representative of first-class Foundry requisite and equipment manufacturers; please state terms and territory.—Box 386, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER desires position; 25 years' practical and technical experience with largest firms in engineering; first-class references.—Address, Box 372, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MALLEABLE CASTINGS.—Gentleman, with good connection, requires up-to-date Foundry to execute orders for large and small castings.—Box 420, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG MAN (23), with six years' General Foundry and 2½ years' Laboratory experience, desires a progressive situation in Foundry or Laboratory; energetic and willing to work; South of England preferred.—Box 410, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PRACTICAL FOUNDRYMAN, age 34 (11 years leading hand with Marine and General Engineering Firm), desires position as Foreman, working not objected to; well trained in Loam, Dry Sand, Green Sand, and Cupola Practice.—Box 414, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

FOR SALE.

THE VALUABLE AND EXTENSIVE WORKS, SITE AND BUILDINGS,

Formerly used by J. Crowley & Company, Limited,

AT MEADOW HALL, SHEFFIELD.

RAILWAY SIDINGS to L.M.S. and L.N.E. Rlys. Area about 11 acres, FREEHOLD. Works well situated and compact. Floor space about 145,000 sq. ft.

Full particulars and terms furnished on application.

THOS. W. WARD LTD.,

ALBION WORKS, SHEFFIELD.

IRON FOUNDRY, old-estabilshed, as going concern; outskirts, Bradford; splendid position; or Working Partner (Moulder) considered, with capital.—Box 418, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

ONE 30-CWT. CUPOLA (by Constructional Company).

Three MOULDING MACHINES.

ONE-TON GEARED LADLE.

MOULDING BOXES, all sizes, Cast Iron and Steel.

INSPECTION INVITED.

J. COLLIS & SONS,

SUNBURY COMMON, MIDDLESEX.

COCHRAN VERTICAL BOILER, 17 ft. 6 in. x 7 ft.; 100 lbs. w.p.; 1919.

BABCOCK BOILER, 1918; 3,000 lbs. evaporation; 160 lbs. w.p.

40-H.P. HORIZONTAL OIL ENGINE, by Hornsby.

50-H.P. VERTICAL SEMI-DIESEL, by Petter.

HARRY H. GARDAM & CO., LTD., STAINES. 'Phone 98.

FOR SALE.—CUPOLA, new condition, No. 4 Jackman; capacity 6 to 7 tons per hour, with Blowing Equipment.—ASHMORE, BENSON, PEASE & Co., LTD., Stockton-on-Tees.

MACHINERY.—*Continued.*

SAND MIXERS.—New and second-hand. Ask us to quote. — W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

MACHINERY, PLANT, &c., FOR SALE.

One HYDRAULIC ACCUMULATOR, 9¾ in. ram, 10 ft. stroke; 700 lbs. working pressure.

One HYDRAULIC ACCUMULATOR, 8 in. ram, 13 ft. stroke; mild steel riveted container, 9 ft. x 10 ft. high; working pressure 1,500 lbs., by the Hydraulic Engineering Company.

One HYDRAULIC PRESS, 9 in. ram, 12 in. stroke, 1 ft. 7 in. daylight, 21 in. high, by Hollings & Guest.

One HYDRAULIC INTENSIFIER, large ram 8½ in., small ram 2½ in., travel of ram 12 in.; large ram 1,500 lbs., small ram 9 tons per sq. in.

Two LANCASHIRE BOILERS, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure.

LANCASHIRE BOILER, 30 ft. x 7 ft. 6 in., re-insure 120 lbs. pressure.

Several HORIZONTAL DOUBLE-GEARED STEAM WINCHES (Clarke, Chapman & Wilsons), each having pair of cylinders 7 in. dia. x 10 in. stroke.

Ten very good HORIZONTAL DOUBLE-GEARED STEAM WINCHES, each having pair of cylinders 4½ in. dia. x 6 in. stroke.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS W. WARD, LTD.,

ALBION WORKS, SHEFFIELD.

MISCELLANEOUS.

FINEST MOULDING SAND for Foundry work. Prices quoted ex pit or delivered; samples sent.—A. OTTERWAY, Thorpe, Surrey. 'Phone: Egham 353.

MOULDERS' MATERIALS.—Plumbago, Blacking, Parting Powder, Terra Flake, Metallic Cement, Wax Core Vents, etc.; carriage paid terms.—W. OLSEN, LTD., Cogan Street, Hull.

CHARCOAL.—Powdered, granulated, lump, blacking; inquiries invited.—J. BUCHANAN & COMPANY, Ashfield Road, Altrincham, Cheshire.

WANTED, Broken Graphite Electrodes and Crucibles, old and new.—Address full particulars to Box 406, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WELDING FLUX.—Highly efficient for Steels, and specially adapted for Welding Tool Steel to ordinary steel shanks; price 15s. per lb.—Write Box 408, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

CHILLED ROLLS.—Advertiser wishes dispose of Secret Mixture for same; successful for many years; illness cause of sale.—Box 412, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. 'Phone 264.

'Phone: 287 SLOUGH.

TRY HAMMOND FIRST

NEW OIL SAND MIXER, latest type ..	£14
NEW ½ Ton LADLE (enclosed gear) ..	£14
NEW 1 Ton LADLE, "COLLIN"	£20
NEW 1½ Ton LADLE, "COLLIN" ..	£24
NEW 2½ Ton LADLE, "GREEN"	£28
3 Ton "EVANS" LADLE, Good as New ..	£30
12 Ton "EVANS" LADLE, Good as New ..	£70
1 Ton DAVY STEEL CONVERTOR, with Motor and Tilting Gear	£120

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND

PLEASE SEND FOR LISTS.

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND, *FOUNDRY MACHINERY MERCHANT.*

14, AUSTRALIA ROAD, SLOUGH.